The JOURNAL OF HEREDITY

A MONTHLY PUBLICATION DEVOTED TO PLANT BREEDING, ANIMAL BREEDING AND EUGENICS

PUBLISHED BY THE
AMERICAN GENETIC ASSOCIATION

VOLUME XI

WASHINGTON, D. C.
1920

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The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. XI, No. 1 January, 1920

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The Journal of Heredity is published monthly by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912.

Date of issue of this number, February 10, 1920.

A LINEATED MAIZE LEAF

This very fine white striping occurs in the uppermost leaves, usually beginning in about the tenth leaf from the seed. The stripes are "usually from 1/10 to 1/4 mm. in width and vary from a few millimeters to many in length." Being closely spaced, they give a grayish effect to the upper leaves, in contrast to the normal green of the lower ones. (Frontispiece).

HERITABLE CHARACTERS OF MAIZE

I. LINEATE LEAVES

Description and Classification of Lineate Plants—Value of Maize as Material for Investigation, and Economic Importance of Discovering Latent Variations

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THE practice of withholding the description of new characters until their genetic behavior has been thoroughly investigated, though sometimes desirable, is leading to much unnecessary duplication of work, and is delaying the progress of knowledge of inheritance in maize. The present article is the first of a series in which it is planned to describe and illustrate the heritable variations of maize as they arise or are discovered.

In order to lessen as far as possible the number of places in which the new characters of this one species are published, and, with the idea of facilitating reference, it is proposed to inaugurate a numbered series. The liberal policy of the Journal of Heredity toward the use of illustrations makes it an especially suitable medium for the publication of short articles of this kind in which photographs play an important part. It was, furthermore, in *The American Breeders Magazine*, the precursor of the present journal, that a number of new characters of maize were first published by R. A. Emerson. It is to be hoped that other workers with maize will find this a convenient place in which to publish illustrations and brief descriptions of their discoveries.

Abnormalities in maize are of such frequent occurrence that it is of course impracticable and probably undesirable to attempt to describe individual variations. As soon, however, as it has been demonstrated that a character is inherited and a stock of seed capable of reproducing the character has been secured, it seems desirable to have the variations brought to the attention of other workers. Once attention has been directed to a variation it is less likely to be overlooked, and the instances where the same variation occurs in unrelated stocks are sooner recognized.

IMPORTANCE OF INVESTIGATIONS IN MAIZE

Our knowledge of the interrelation of Mendelian characters should proceed with increasing rapidity as the number of such characters increases. If the linear arrangement of characters in inheritance should be found to hold for maize as for Drosophila, the proper location of a new character becomes easier as the number of characters whose location is known increases.

Although a majority of the heritable differences in maize are of such a complex nature as to make Mendelian analysis difficult or impossible, alternative characters are coming to light in such numbers as to warrant the belief that maize will rival Drosophila as material for the investigation of the linear arrangement of factors and of chromosomes as the bearers of the determinats of characters. A knowledge of the variations latent in the commercial varieties of maize is furthermore of great economic importance, since most of the variant forms are less productive than the normal forms, and they must be recognized to be eliminated.

DESCRIPTION OF THE LINEATE PLANTS

The character here described, which is designated "lineate leaves," consists of a very fine striping on the blades of

the upper leaves. The lower leaves of plants possessing this character are normal, the striping first making its appearance on about the tenth leaf from the seed. From the tenth to the uppermost, the blades are marked with fine, narrow, nearly white stripes which are usually from 1/10 to 1/4 mm. in width and vary from a few millimeters to many centimeters in length. In pronounced cases the stripes are separated by not more than their width. The general effect of the closely spaced fine stripes is to give the blade a grayish appearance that contrasts sharply with the uniform green of normal leaves. (See frontispiece.)

Lineate plants first appeared, or at least were first observed, in four progenies of a hybrid sweet corn that was being grown at Lanham, Md., in 1918. The sweet corn in which the lineate plants occurred was a hybrid between Stowells' Evergreen and a prolific variety of field corn from Brownsville, Tex.[1]

The original cross was made in Texas in 1912. In 1913 the F_1 population was grown in an isolated block at Victoria, Tex. In 1914 an F_2 population was grown at Lanham, Md., and from the crossing of two plants the ear designated Ph124 was secured.

Plants from Ph124 were grown in Chula Vista, Cal., in 1915, and again in Lanham, Md., in 1916 when one cross-pollinated ear, Ph124LI, was secured. In 1917 seeds of Ph124 were again planted at Lanham, together with seeds of Ph124L1. From these plantings there were secured 16 cross-pollinated ears of Ph124, 31 cross-pollinated ears of Ph 124L1 and 8 crosses between Ph124 and Ph124L1.

In 1918 the 16 cross-pollinated ears of the Ph124 progeny and 3 of the crosses between Ph124 and Ph124L1 were planted. Lineate plants occurred in 3 of the 16 progenies of Ph124 and in one of the crosses between Ph124 and Ph124L1. The ratio of lineate to green plants is shown in Table I.

The ratios are all reasonably close to the monohybrid 3:1, and the results may be explained by assuming that one parent of Ph124 was heterozygous for lineate, a simple Mendelian character recessive to the normal green. If the lineate character was the result of a mutation in a single gamete this mutation must have occurred in 1913 in one of the grandparents of Ph124.

This follows from the fact that lineate plants have been confined to descendants of Ph124, that approximately one-fourth of the cross-pollinated progenies of Ph124 produced lineate plants (4 out of 19) and that in the progenies in which lineate appeared one-fourth of the plants exhibited this character.

Six hand-pollinated ears were secured from the progenies shown in Table I. One of these six ears represented a cross between a normal green female plant and a lineate male, one was the result of crossing two lineate plants, a

Table I.—*Showing the Number of Lineate and the Number of Green Plants in Four Progenies Grown from Hand-Pollinated Ears.*

Progeny designation	No. of green plants	No. of lineate plants	Expected 3:1	
Ph124L2	15	7	16.5	5.5
Ph124L3	20	11	23.3	7.7
Ph124L5	18	6	18.0	6.0
Ph124L10	24	8	24.0	8.0
Total	77	32	82	27

[1] The history of this cross is discussed in "Breeding Sweet Corn Resistant to the Corn Ear-worm," Collins, G. N., and Kempton, J. H., *Journ. Agri. Res.*, XI, No. 11, pp. 449–572, December 10, 1917.

third resulted from crossing two normal green plants, and the remaining three ears were the result of self-pollinating lineate plants.

DEGREE OF LINEATION VARIABLE

Seeds from all six ears were planted in 1919, and all of the progenies produced some lineate plants. The progenies, however, were not alike, and it was apparent that this character was extremely variable in expression. In classifying the plants an attempt was made to estimate the degree of lineation. A scale of ten grades was adopted, and although the classes were arbitrary it was found that independent observers were able to place the plants in essentially the same grades. The classification of the plants secured from the progenies of the six ears is shown in Table II.

With the exception of the two green plants, found in the progeny of a self-pollinated lineate plant, the results accord well with the expectation based on the assumption that lineate is a simple Mendelian character recessive to the normal form. The two green plants will be tested this coming season, and while it is within the realm of possibility that they are in reality lineate, the fact that they occurred in the progeny which exhibited the most intense expression of lineation is an argument against this explanation.

RESULTS FROM RELATED PROGENIES

In addition to the six ears secured from progenies which produced lineate plants in 1918, there were twelve hand-pollinated ears from related progenies which produced no lineate plants in 1918. All of these ears are directly descended from the ear Ph124.

Seeds from the twelve ears were planted in 1919, and the progeny of five of these produced some lineated plants. The five progenies are shown in Table III.

TABLE II.—*Proportion of Green to Lineate Plants, the Average Degree of Lineation and the Average Leaf from the Seed on Which Lineations First Appeared.*

Designation of progeny	Female parent	Male parent	No. of green plants	No. of lineate plants	Degree of lineation	Aver. leaf on which lineations first appeared
Ph124L2L1	Lineate	Self	0	28	5.37 ± .20	10.7
Ph124L10L2	Lineate	Self	0	41	2.74 ± .28	11.8
Ph124L10L3	Lineate	Self	2	19	5.84 ± .14	9.3
Ph124L2L2	Green	Lineate	15	14	4.00 ± .49	10.2
Ph124L5L1	Lineate	Lineate	0	35	5.78 ± .28	9.5
Ph124L10L1	Green	Green	24	3	3.00 ± *	9.0

* Probable error not calculated, since only three plants are involved in this average.

TABLE III.—*Proportion of Green to Lineate Plants in the Progeny of Five Hand-pollinated Ears.*

Designation of progeny	Female parent	Male parent	No. of green	No. of lineate
Ph124L4L1	Green	Self	69	3
Ph124L12L1	Green	Self	18	7
Ph124L13L1	Green	Self	7	3
Ph124L20L1	Green	Self	16	9
Ph124L9L1	Green	Green	124	1

The fact that five of these twelve ears produced lineate plants, although the parental progenies were normal green, involves no genetic complexities. The progenies which produced these five ears were all the result of crossing sister plants, and it seems not unreasonable to assume that one parent in each combination was heterozygous for lineate and the other homozygous for normal green.

The ratio of green to lineate plants in three of the progenies shown in Table III is as close an approximation to the Mendelian monohybrid 3:1 as could be expected with the small numbers involved, but the remaining two progenies clearly do not conform.

It may well be that in these two aberrant progenies we are witnessing a recurrence of the mutation which will behave subsequently as a Mendelian unit character in full accord with the progenies just discussed. An alternative explanation lies in the wide variation in the expression of this character, indicating the influence of a number of modifying factors which may obscure the true nature of most of the lineate plants.

The variations in expression, however, are no larger than is found in most strains of japonica or similar stripe patterns. Japonica forms of striping similarly occur in aberrant ratios, several instances having appeared in our breeding blocks where one or two plants in several hundred exhibit white striping. The same progenies produce a few striped plants in successive plantings. This behavior has not interfered with analysis in progenies where the ratios are Mendelian and the segregation is sharp. There is, therefore, little reason why lineate leaves should not take their place with the other chlorophyll variations in maize affording another character with which to test the linear arrangement of factors.

The Heredity and Environment of a Great Botanist

The story of Joseph Hooker's lifework is, in one aspect, the history of the share taken by botany in establishing the theory of evolution and the effect produced upon it by acceptance of that theory. He began with unrivalled opportunities and made unrivalled use of them. As a botanist, he was born in the purple, for in the realm of botany his father, Sir William Hooker, was one of the chief princes, and he had at hand his father's splendid herbarium and the botanic garden which he had made one of the scientific glories of Glasgow University.

Joseph Hooker's earliest recollections are preserved in an autobiographical fragment, set down late in his life. Noteworthy among the events that emerge from childish forgetfulness, like hill-tops above a sea of mist, is the early love of nature, and especially of plants, inborn in him and indeed inherited from both lines of his parentage. His father and his mother's father were both botanists, and singularly enough they both began their studies as such with the mosses, quite independently of one another; so that, being confessedly "a born Muscologist," he playfully dubs himself "the puppet of Natural Selection."—From Life and Letters of Sir Joseph Dalton Hooker, by Leonard Huxley; in 2 vols. London: John Murray, 1918.

HEREDITY AND ECONOMICAL PRODUCTION OF FOOD

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WITHIN the last century, evolution, used in a broad sense, has been unusually conspicuous in the field of mechanics and engineering. Just why that is true, while evolution among living creatures has progressed more slowly and has attracted less general attention, may be seen from a few well-known facts.

EDUCATION HAS FOSTERED ENGINEERING PROGRESS

Progress in any field, as a rule, is approximately in proportion to the amount of study given that field by persons of progressive thought and action. With the gradual development of the United States, engineering long ago became the life study of thousands. Opportunities were plentiful, and well-trained men were ready to take them. The examples and the successes of the first spurred others to similar training. The result attained was inevitable, and today the United States has not only great systems of railroads, irrigation projects, highways and mechanical industries, but in addition it has thousands of people who are expert in various branches of such work and can press on to still greater and wider engineering achievements.

Even in the rather specialized field of agricultural machinery we must remember that the progress made is due to the work of many minds. A few conspicuous names, it is true, loom up above the rest, but countless improvements and refinements rather than a few revolutionary ideas have contributed to the present advancement in labor-saving farm machinery.

I have in mind the experimental staff of a firm manufacturing farm tractors and implements Every fall the chief designer and one or more of his assistants pack their grips for a circuit of State fairs. Mingling with farmers at the machinery exhibits, these specialists seek for new ideas and suggestions. In addition they try to learn what new implements or machines would be likely to meet with favor.

Such efforts explain why American farmers are so well equipped with machinery that multiplies human labor in a way that has won the wonder of other nations. It explains also why with high-priced labor the United States can produce many kinds of food, especially grains, hay, and other bulky crops, so cheaply. But in the field of meat food products, so important to the vigor of a nation, our progress, though noteworthy, appears capable of extensive developments.

The drift of thought has been so gradual as to attract slight attention by persons interested especially in evolution in the organic sense. Yet the enormous preponderance of effort in mechanical development is seen in the enrollment of almost any college or university having a wide range in its curriculum. A graduating class in a middle western university a few years ago included 400 students. Approximately one-fourth were trained in engineering, while only sixteen—less than one-twentieth—were trained in agriculture, and only one of the sixteen had made a study of animal genetics. While such a striking ratio may not be typical today, especially in universities having strong agricultural courses, it indicates at least the subordinate place the study of genetics—from an agricultural angle—has occupied in the general field of education.

The study of heredity as it concerns the production of livestock in the United States has gone forward under the efforts and interest of competent and energetic investigators. There has been gratifying achievement. The champion dairy cow of today seldom retains her laurels, earned by a large yield, for more than a few years. Much the same is true in the show ring. In fact, with all stock, constant rivalry among breeders soon displaces the winners of one year with new champions. Yet in considering improvement in the average sense, we are forcibly reminded that the total number of exhibitors is rather small in proportion to the total number of livestock owners. In a similar way a few high records of production have earned world-wide attention. Such records are merely a few peaks in a statistical chart where the general average production is low.

The average yields of milk per dairy cow in fourteen prominent countries show that the United States is in the sixth place, being excelled by the Netherlands, Switzerland, Denmark, Germany, and Canada. Our ability to produce scores of cows which yield more than 20,000 pounds of milk a year is ample proof that our national production of less than 4,000 pounds per year per cow, in the last analysis, is a reflection of inattention and average lack of applied skill. The dairy cow is a good example—probably the best—because her production is so readily measured and because there is so much uniform evidence in various countries. Yet the same principle and similar facts apply to other lines of production.

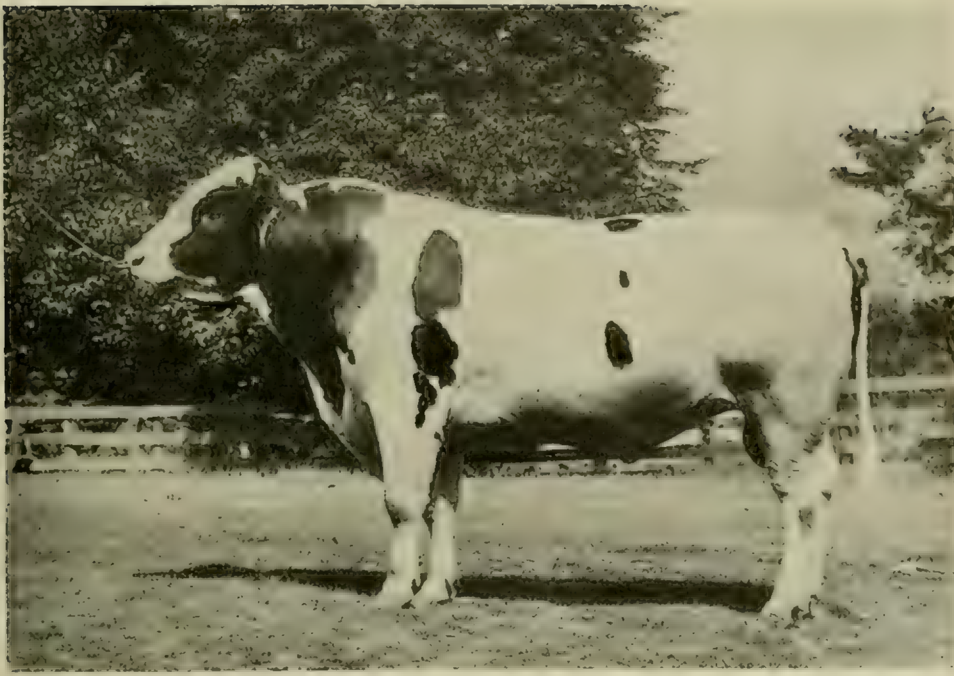
Even a superficial consideration of the facts mentioned points to the proggress which livestock raisers in the United States would make if next year 1,000 persons began thinking intelligently about animal breeding for every one person who thought about it this year. That would bring about a condition whereby combined human effort in studying and applying laws of heredity to livestock breeding would approximate the effort being devoted to mechanical progress. It would help to attain in livestock evolution a great average advance without in any way interfering with success in producing individual world beaters.

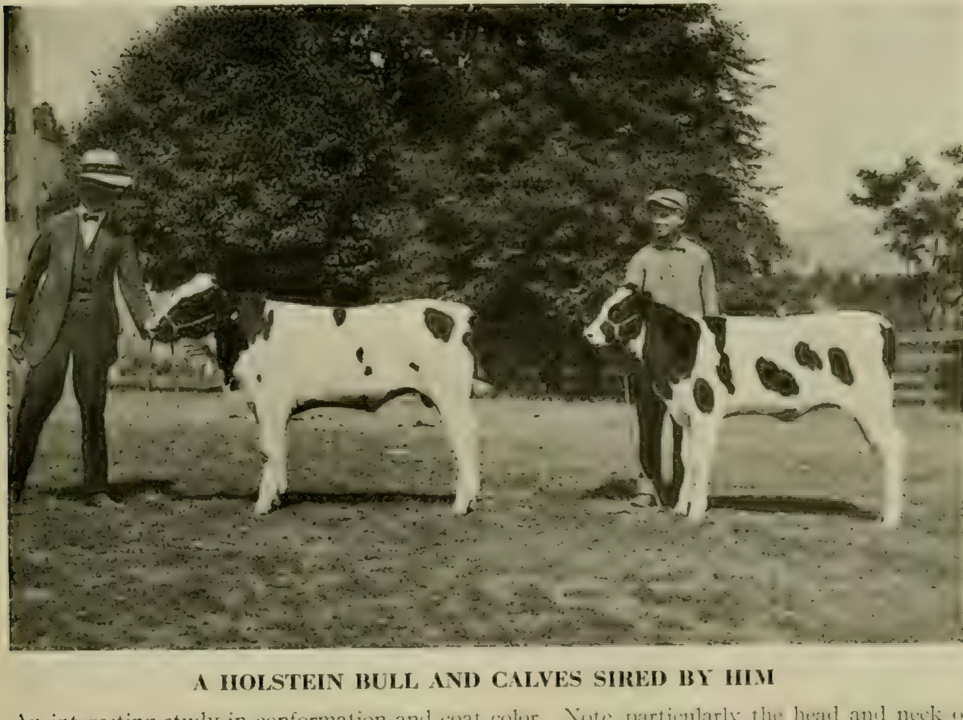
Without going into detail, the economical production of meat, dairy products, poultry products, and animal power is closely related to breeding. The well-bred steer is economical to raise because a relatively less proportion of feed goes into his maintenance and a greater proportion goes into his gain in weight. Besides, his quality is better and the period of growth to profitable market age is shorter. The same is true, with some qualifications, of swine, sheep, poultry, and most other stock. In short, skillful breeding results in numerous benefits, including economy of production, a quicker turnover of investment, progressive improvement of herds and flocks, and better meat food products for consumers.

TEACHING HEREDITY TO MANY

Notwithstanding the efforts of agricultural colleges and similar agencies in the United States, farmers are not as familiar with the basic laws of breeding as they are with the basic laws of mechanics. For every person who understands Mendel's law at least a score know the law of the lever. This comparison may seem odd because the law of the lever appears so much simpler, yet it is simpler chiefly because civilization has thought in mechanical terms. Man owned livestock long before he owned a wheeled cart. Bringing the comparison to modern times we may safely assert that 1,000 persons understand a carburetor for every one who knows a chromosome.

In the endeavor to stimulate interest in heredity and in the basic principles of breeding, the United States Department of Agriculture lately has directed attention to the use of purebred sires for all livestock. Of the various methods of animal improvement the principle of grading up through the use of pure-bred males is probably the most practical and economical. In June, 1919, the department proposed





A HOLSTEIN BULL AND CALVES SIRED BY HIM

An interesting study in conformation and coat color. Note particularly the head and neck of the bull calf at the left. America should be better equipped with animals such as these to meet the increasing needs of the coming years. "Skillful breeding results in numerous benefits, including economy of production, a quicker turnover of investment, progressive improvement of herds and flocks, and better meat food products for consumers." (Fig. 1.)

to the extension directors of the various states the desirability of conducting a nation-wide effort to induce livestock owners to replace scrub and grade sires with pure-breds. More than that, the desirability of improving the quality of pure-bred sires themselves was presented. In addition to consulting livestock experts of the agricultural colleges, the Federal Department of Agriculture presented a tentative plan of the proposed campaign to others also, including county agents, agricultural editors, officers of livestock associations, secretaries of boards of agriculture, livestock sanitary officials, prominent breeders, and others who might be interested. Of nearly 600 replies received, approximately 97% favored such a campaign without qualifications. Most of the remaining 3% made specific suggestions for modifications of the plan, and a few either were skeptical or presented adverse opinions. The cream of the suggestions, after careful consideration, was embodied in the original plan, which was also altered to meet various local conditions discussed in a number of the letters received. The revised plan of the campaign was presented in August and has met with practically unanimous approval. The agricultural press has devoted space freely to the support of the work, and 41 states already have made the campaign, popularly known as the "Better Sires-Better Stock" movement, a part of their extension activities. It was definitely inaugurated as a Federal-State enterprise on October 1, 1919. Since then more than 25,000 pieces of literature have been distributed to meet requests from the field. Two-thirds of this constituted enrollment blanks, which when properly filled out entitle the person using only pure-bred sires for all his livestock to official recognition by the United States Department of Agriculture and by the state in which he lives. The remaining one-third was miscellaneous literature, including a plan of the campaign, and also pointing out the policies under which the campaign is conducted.

As would be expected, the enrollment records of persons using pure-bred sires show that a majority of them likewise have some pure-bred female stock. A considerable amount of grade stock is noted, also some cross-breds. This condition is true in a broad sense of all the kinds of animals included in the campaign, namely, cattle, horses, asses, swine, sheep, goats, and poultry. The records show that users of pure-bred sires keep only a few scrub females, the remnant probably of the first foundation stock.

FARMERS' BULLETIN ON BREEDING PRINCIPLES

Reinforcing the Federal-State effort to encourage the use of better sires, Dr. Sewall Wright, of the Animal Husbandry Division of the Department of Agriculture, has prepared a manuscript on breeding principles for the Farmers' Bulletin series. This contribution is believed to fill an important gap in the agricultural literature of the United States, being of service not only to breeders directly but likewise to extension workers and others who address farmers' gatherings. The underlying thought in the better-sires movement is to create in the minds of thousands, and, if possible, millions, of livestock raisers an interest in the basic principles of animal breeding. The field of improvement in livestock is as vast as that of mechanics. It is believed also that thousands of farmers who have an inherent preference for working with living things rather than machinery will welcome the opportunity to replace their fragmentary and inaccurate knowledge of livestock breeding with the dependable information contained in the bulletin mentioned.

Thus heredity, in addition to being a study calling for keen effort by those who would solve its mysteries, becomes an effective agency when presented and explained to those who as owners of livestock are expected to supply the food needs of the country.

Members of the American Genetic Association may render wide public service by helping breeders assimilate and apply principles of heredity already known but not generally used.

A PRODUCT OF SELECT BREEDING

To develop a fine type of livestock is as noteworthy an achievement as to complete a fine piece of engineering. The animal pictured above has been produced only after careful selection and proper mating of ancestors. Successful breeders pay rigid attention to the laws of inheritance. The study of genetics, to make more widespread a knowledge of these laws, is worthy of more prominence in our educational institutions. What would be the effect on livestock raising in the United States "if next year 1,000 persons began thinking intelligently about animal breeding for every one person who thought about it this year? That would bring about a condition whereby combined human effort in studying and applying laws of heredity to livestock breeding would approximate the effort being devoted to mechanical progress." (Fig. 2.)

A NOTE ON THE ORIGIN OF PIEBALD SPOTTING IN DOGS

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SEVERAL varieties of dogs such as foxhounds, beagles, Boston terriers, St. Bernards, and collies, are characterized by the possession of a piebald coat pattern. In this pattern, large and relatively regular, and definitely localized white spots occur on a colored ground. The extreme form of such spotting is seen in bull terriers. Here the entire skin and coat is commonly unpigmented, the eyes alone being colored. The appearance of exceptional individuals, however, in which small red or yellowish spots are found on the head, near the eyes or ears, shows that the pattern is really one of greatly reduced spotting and not of true albinism.

On the other extreme of the spotted series one finds, among breeds normally solid colored, certain animals in which one or more of the feet may be white, or which may possess a white spot or blaze on the chest. Data on Great Danes, collected from the American Kennel Club Stud Books indicate that such spots are hereditary and are due to a factor which is hypostatic to solid colored coat. (Little and Jones,[1] 1919.)

Such animals, which show a slight degree of white spotting, have, by some been considered as being forms from which, by rigid selection, spotted breeds have been developed. That this is also the case in rodents has been stated by Castle[2] (1916, page 125) as follows: ". . . Rarely does it (the degree of spotting) go beyond these slight and inconspicuous markings. But under artificial selection in captivity it is possible rapidly to increase the extent of the white areas in the coat, which then takes on striking and often rather definite outlines, as in Dutch marked rabbits, English rabbits, hooded rats, and black-eyed white mice. . . . The production of white-spotted races from small beginnings observed in wild stocks has been accomplished in the laboratory by Castle and Phillips in the case of Peromyscus, and by Little in the case of the house mouse (unpublished data)."

Inasmuch as the inference from the above is that the writer, among others, has by selection developed from a wild race of rodents with a small amount of spotting, a race of heavily spotted animals, it should be stated that progress from the original degree of spotting observed, in the wild mouse used, was made *only after a cross with a tame race and that following the cross progress was so rapid that the introduction of modifying factors by the unspotted race used undoubtedly had occurred.*

EVIDENCE THAT SPOTTING IN DOGS MAY OCCUR BY MUTATION

By this I do not mean to assert that some progress might not be made by selection alone within the race in which the spotting originated, but merely to point out that there is little or no experimental evidence that the "Dutch" or "English" rabbits or black-eyed white mice or hooded rats mentioned by Castle were developed by selection alone, within a wild race, showing a minute degree of spotting. It is possible that this is the case, and will remain so until their origin *de novo* is demonstrated and analyzed; but in the meantime it is interesting to review two cases in dogs which give direct evidence as to the origin of spotted individuals and which suggest that a spotted race

[1] Little, C. C., and Jones, E. E., Journal of Heredity, October, 1919, Vol. x, No. 7.
[2] Castle, W. E., "Genetics and Eugenics." Harvard University Press, Cambridge, Mass.

PIEBALD COAT PATTERNS

Coat patterns, such as these, characterize several varieties of dogs, but similar spotting is occasionally found among breeds that are normally solid colored. Study of these cases indicates that such spotting is hereditary. Nos. 1 and 2 above represent Airedale terriers, and No. 3 a Scottish terrier puppy. (Fig. 3.)

may arise from a self race, by mutation, without passing through a series of minute gradations directed by selection.

The first case to be reviewed is that of a spotted Scottish terrier puppy (Fig. 3, No. 3) born in my father's kennels, January 22, 1909. This puppy, a bitch, was the only individual born in the first litter obtained from two young solid-colored, pedigreed, and registered Scottish terriers, neither of which had been out of the kennels from the time at which they became sexually mature. The spotted puppy in question was born dead, a fact not very suprising in view of the litter being the first produced by the bitch. The two parents are far from closely related as a glance at the pedigree (Table I) will show. If the spotted coat of the exceptional puppy is hypostatic to solid colored coat, it may be considered as introduced by the germ cells of both parents either by parallel mutations occurring in each of them, or by being contributed to each of them by a common ancestor. If the idea of the occurrence of parallel mutations on each side of the pedigree is considered as far fetched, we must look on both sides of its pedigree for an ancestor or ancestors in common. In this connection, Balmacron Prince occurring in the fourth generation on the male side and in the third generation on the female side appears to be the only possibility. If this dog was, in respect to hypostatic piebald spotting, DR in formula, he might well have introduced this spotting into the cross. The result would have been that, after several generations, the proper DR x DR mating would have been made, and an RR or spotted individual would have resulted.

The fact of particular interest from the viewpoint of the origin of spotting is that the puppy had white areas of considerable extent and could in no way be considered a product of selection of minute variations possessed by lightly spotted ancestors.

The second case presents even more interesting features. It deals with the appearance of spotted individuals in two litters of Airedale terriers. The

TABLE I.—*Pedigree of Spotted Scottish Terrier Puppy (Fig. 3, No. 3)*

(Sire) Newcastle Carom	Clan Bonnacord Jock	Seafield Rascal	Seafield	
			Seafield Nora	
		Bonnacord Jewel	Camowen Laddie	
			Glenhin Beauty	
	Nosegay Cornflower	Nosegay Crimson Rambler	Balmacron Thistle	Balmacron Prince
				Balmacron Tib
			Baberton Lass	Balmacron Prince
				Lauriston Lass
		Valdora Gem	Roxburgh	
			Loyne Ginger	
(Dam) Newcastle Confidence	Brynhir Barber	Undercliffe Sandy	Cairn Dhu	
			Corrie Linnhe	
		Foula	Kildee	
			Zelta	
	Morachi	Baberton Prince	Balmacron Prince	
			Baberton Beauty	
		Snapshot	Guide	
			Ayrshire Beauty	

case was reported to me by Mr. Frederic Hood of Watertown, Mass., owner of the Boxwood Kennels. Mr. Hood has been most kind in placing the particulars of the case, as well as two of the puppies themselves, at my disposal. The interest which he has shown might well be taken as a model by all breeders and fanciers, who by adopting a similar attitude might do much to increase opportunities for cooperation with scientific institutions.

The history of this case is briefly as follows: A pedigreed and registered bitch (No. 182), an excellent specimen of the breed, was bred to a typical dog (No. 216), pedigreed, registered, and a bench show-winner. In due time a litter of seven pups, one male and six females, was obtained. Of these two, the male and one female, were heavily spotted with white. They were, according to Mr. Hood's manager, very similar to, though of course not identical with, the two spotted pups figured in Fig. 3, Nos. 1 and 2. The five remaining pups were all normal, and included among their number one which has developed into one of the best American bred Airedale bitches now being shown. This bitch (No. 228) was bred to a different dog (No. 294) and produced a litter of six puppies, three males and three females, all dead. Two of them, both males, were kindly sent to me in preservative by Mr. Hood and are figured in Fig. 3, Nos. 1 and 2. In conformation and ground color they are typical Airedales, but in size No. 1 is larger and No. 2 a bit smaller than is the average Airedale pup at birth. The other four pups in the litter were entirely typical in color and conformation and were born before the spotted pups which were the last two in the litter. One of the typical pups had, however, a cowl of his own skin which stretched bag-like over his shoulders and head. The head and neck were far from being properly developed. This puppy I did not see, but the description is taken from the personal observation of Mr. E. Warburton, the manager of the Boxwood Kennels, whose accuracy of description need not be doubted.

The pedigrees of the two litters containing spotted pups are given herewith. It will be noticed that ♂ No. 135 occurs in both pedigrees and on both sides of each pedigre. ♀No. 140 also occurs on both sides of the second pedigree and

Table II.—*Pedigree of Spotted Airedale Terriers.*

First litter containing spotted pups

*5 typical; 2 spotted puppies;
- 216
  - 208
    - 162
      - 92
      - 103
    - 147
      - 61
      - 74
  - 201
    - 135
      - 77
      - 86
    - 149
      - 54
      - 63
- 182
  - 104
    - 98
      - 80
        - 135
        - 140
      - 69
    - 76
      - 56
      - 38
  - 108
    - 83
      - 72
      - 45
    - 96
      - 135
      - 149

* Including ♀ 228

Second litter containing spotted pups

4 typical; 2 spotted puppies; Fig. 3, Nos. 1 and 2.
- 294
  - 218
    - 129
      - 80
        - 135
        - 140
      - 57
    - 117
      - 79
      - 58
  - 221
    - 79
      - 44
      - 26
    - 90
      - 62
      - 55
- 228
  - 216
    - 208
      - 162
      - 147
    - 201
      - 135
      - 149
  - 182
    - 104
      - 98
        - 80
          - 135
          - 140
        - 69
      - 76
    - 108
      - 83
      - 96
        - 135
        - 149

on one side of the first. It seems very likely that if a mutation producing spotted coat color took place in the gametes of any one individual, that ♂ No. 135 or one of its ancestors, was the animal in question.

Examination of Fig. 3, Nos. 1 and 2, shows that the amount of white on the coat of these puppies is considerable and that, like the Scottish terrier puppy already described, there is no possibility of its having been developed by selection from minute beginnings.

It is hoped that it will be possible to obtain certain of the animals from the spotted Airedale stock for breeding purposes and thus to ascertain more definitely the genetic nature of the variation.

University Wants Photographs of Twin Calves

The Department of Genetics at the University of Wisconsin is making a study of twins, particularly in cattle, and desires to secure photographs of twin calves. Those of spotted breeds are especially wanted. In this connection, particular interest attaches to the degree of similarity of markings on the duplicated parts of double monsters, such as those with two heads and a single body, or two bodies and a single head. These freaks are often "stuffed" or otherwise preserved, and the college will appreciate receiving any information relating to the existence of such specimens in museums or elsewhere, and how photographs or accurate sketches might be obtained. It is believed that a more accurate knowledge of the conditions in such cases will help toward an understanding of the larger problems of inheritance in cattle and other animals. Those who have any information that will assist in the above studies should write to the Department of Genetics, University of Wisconsin, Madison.

TEAS' HYBRID CATALPA

An Illustration of the Greater Vigor of Hybrids; Increased Growth and Hardiness as a Result of Crossing; Illustrating Definite Principles of Heredity

D. F. JONES AND W. O. FILLEY
Connecticut Agricultural Experiment Station, New Haven.

ALTHOUGH the number of artificially produced hybrid trees is small, compared to the number of crosses among other species, several noteworthy trees have been described from time to time which do not conform to any known kinds, and they have been attributed to an assumed hybrid ancestry. A good example is found in the James River walnut,[1] considered to be the result of a natural cross-fertilization of *Juglans regia* by J. *cinerea.* A similar tree has been described by Sargent[2]. Likewise the Lucombe oak,[3] the Carolina poplar,[3] the London plane[3] and the fir trees which originated at Bulgnéville, France,[4] have been regarded, upon reasonably good evidence, as natural hybrids. Lastly, Teas' hybrid catalpa so plainly exhibited characters of both *Catalpa Kaempferi* and *C. bignonioides* that Sargent[5] was convinced of its double lineage.

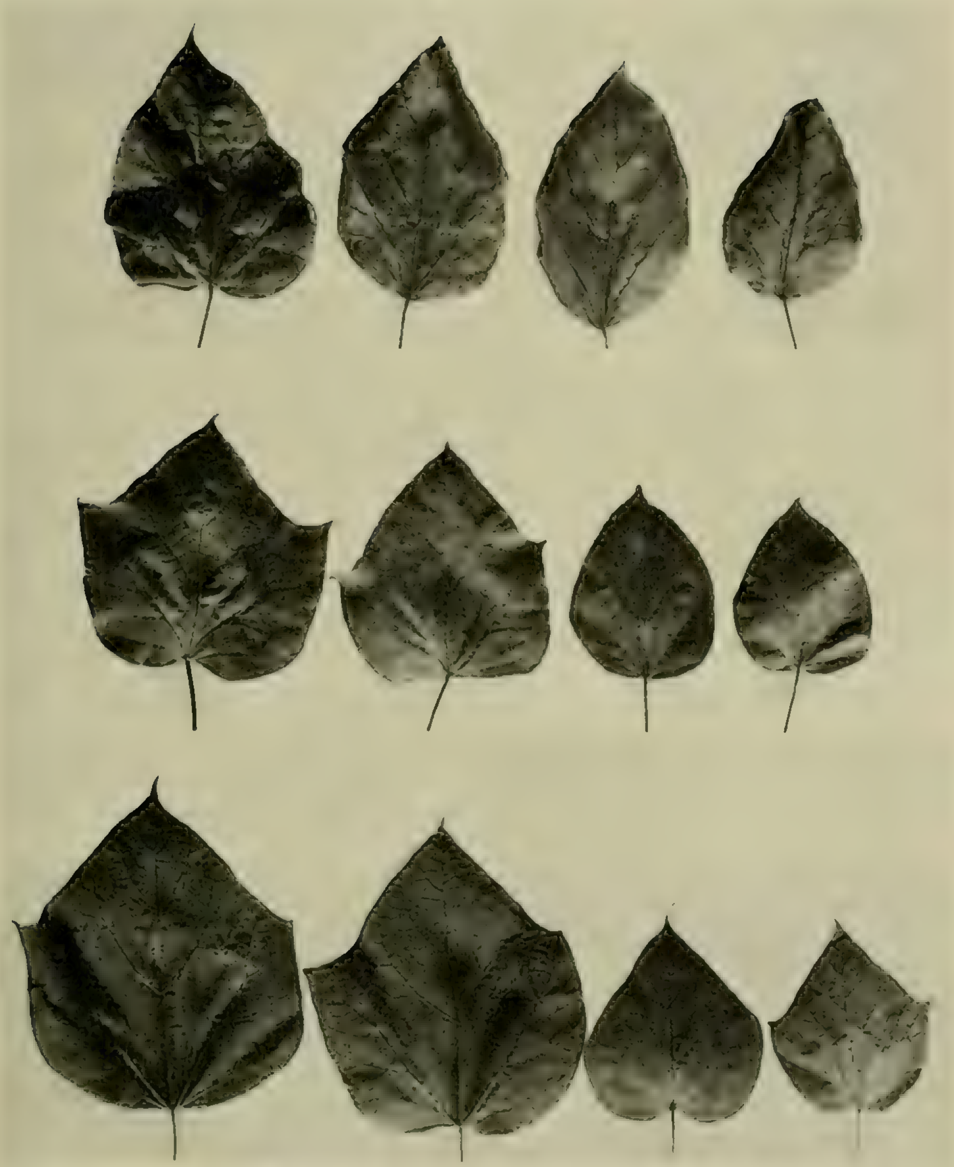
This latter cross has since been made from known trees of the two suspected parents. It is of more interest than as a mere illustration of a hybrid tree, to note that this plant agrees in every particular with the tree which was attributed to the parentage deduced from the characters it possessed together with the circumstances attending its origin.

ORIGIN OF THE HYBRID CATALPA

The history of the original hybrid is as follows, quoting from Sargent: "J. C. Teas of Carthage, Mo., while living in Indiana in 1864, purchased a seedling catalpa from Mahlon Moon of Morrisville, Pa., who raised it from seed procured from Japan by Hovey & Co., the Boston seedsmen. According to the statement of Mr. Teas, to whom I am indebted for the facts in the case, this tree, which proved to be *C. Kaempferi*, was planted in his nursery among or near plants of *C. bignonioides* and *C. speciosa*, the two North American species; and it produced in due time one pod of seeds which were quite unlike those of any catalpa with which Mr. Teas was acquainted. The seeds were planted and gave rise to a tree almost intermediate in character between *C. Kaempferi* and one of the American species. The appearance of this seedling tree and its progeny suggests that the pollen from a flower of one of the American catalpas had fertilized a flower of the Japanese tree. The American parent was probably *C. bignonioides*, although Mr. Teas is inclined to believe that it was *C. speciosa.* The latter flowers two or three weeks earlier than the Japanese species, whereas the former flowers contemporaneously with that species during the first week of July.

"Whatever may have been its origin, the hybrid . . . is an erect, vigorous, and rapid-growing tree, with the thin, scaly bark of the American species. The leaves are sharply three-lobed, or rarely entire, and more or less cordate at the base; they are slightly pubescent on the lower surface, and the mid-rib and primary veins are covered with scattered hairs; they are 12 to 15 inches

[1] Peter Bisset, "The James River Walnut." JOURNAL OF HEREDITY, 1914, 5:98–101.
[2] C. S. Sargent, "A Hybrid Walnut Tree." *Garden and Forest*, 1894, 7:434–436.
[3] W. H. Lamb, "Hybrid Trees." JOURNAL OF HEREDITY, 1916, 7:311–319.
[4] *Garden and Forest*, 1890, 3:308.
[5] C. S. Sargent, "A Hybrid Catalpa." *Garden and Forest*, 1889, 2:303–305.



COMPARING THE LEAVES OF DIFFERENT SPECIES OF CATALPA

The leaves at the top are those of *C. bignonioides*, characterized by their ovate shape, with entire margin and pubescence only on the lower surfaces. Those in the center row are of *C. Kaempferi* which are generally three-lobed with velvety pubescence only on their upper surfaces. The leaves of the hybrid are shown at the bottom. Characters of both parents are expressed in these leaves which are generally three-lobed and pubescent on both surfaces. In color markings they more nearly represent the Japanese species. (Fig. 4.)

long and 10 to 12 inches broad. The inflorescence, which is 18 to 20 inches long by 10 inches wide, is composed of two or three hundred fragrant flowers about an inch long, the corolla slightly tinged with yellow in the throat, and handsomely marked with broad purple stripes. The fruit is from 12 to 15 inches in length and not more than a quarter of an inch thick in the middle. The wings of the seed are half an inch in length and one-eighth of an inch in width, and, like the others of the genus, are tufted with long, white hairs.

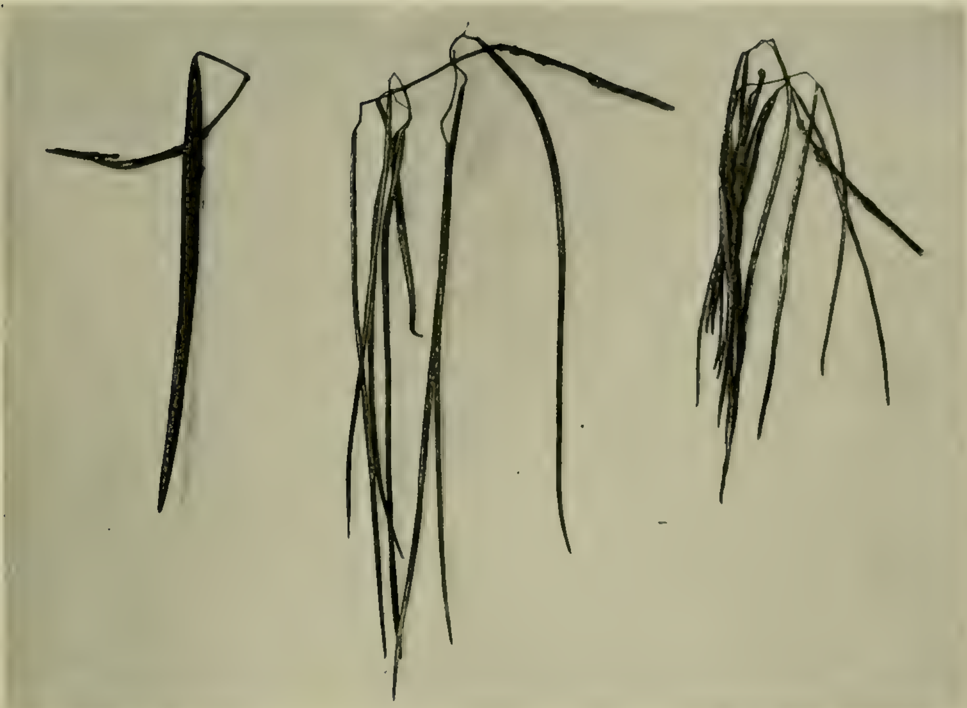
"The leaves of this tree are much larger than those of either of its parents, having, when they first appear, the velvety character and purple color peculiar to those of the Japanese plant, and the reddish spot at the insertion of the petiole with the leaf-blade which characterizes that species. They more generally resemble those of the Japanese species in shape, color and texture, while the pubescence which covers the lower surface is almost intermediate in character between those of the American and of the Japanese species. The inflorescence is much larger than that of the American or of the Japanese plants, being fully twice as large as that of *C. bignonioides* and more than three times the size of *C. Kaempferi*. The flowers are intermediate in size; in color and markings they most resemble those of the American species, although a tinge of yellow in the throat of the corolla points to their Japanese descent. The fruit of the hybrid is almost intermediate in size between those of the two parents, as are the seeds, which are perfectly fertile and often reproduce the original form in every particular. When, however, seedlings show a tendency to vary from the original form the variation is generally in the direction of the Japanese rather than of the American parent.

EXCELS JAPANESE SPECIES AS ORNAMENTAL TREE

"The hybrid is a more vigorous tree than either of the American or the Japanese species, and it grows rather more rapidly. It is too soon to speak of its value as a timber-tree, as the largest specimens in the western states where this tree has been much more generally planted than at the east, according to Mr. Teas, only 40 to 50 feet high, with trunks which do not exceed yet a diameter of 18 inches. Of its value as an ornamental tree there can be no doubt. Its larger size and more rapid growth, its better habit and more showy inflorescence make it a far more valuable ornamental tree than the

CATALPA SEEDS

The seeds of the hybrid are intermediate in size between those of the parents but are much greater in number, and the wings, "like the others of the genus are tufted with long, white hairs." (Fig. 5.)



PODS OF THE HYBRID CATALPA AND PARENT SPECIES

"The fruit is from 12 to 15 inches in length and not more than a quarter of an inch thick in the middle," and thus intermediate in size, but the pods are numerous and contain many seeds. The number of flower clusters and total amount of seed produced per tree is much greater on the hybrid than on either of the parent species. (Fig. 6.)

Japanese species; it is more hardy than either of the North American species, and, although the flowers are smaller, the panicles and the number of individual flowers are much larger."

In 1911 Dr. E. M. East, at the Connecticut Experiment Station, crossed *Catalpa bignonioides* by *C. Kaempferi*, this being the reciprocal combination of Teas' undoubted hybrid. The actual pollination was made by Prof. H. K. Hayes. The trees were grown and measured by him for the first years of the experiment and later came into the hands of the writers. The cross was made by emasculating the flowers of the *bignonioides* parent, enclosing them in bags and later applying pollen by hand. Seed was collected from the same trees as used in making the cross which were well isolated from each other. The three lots of seed were sown in the spring of 1912. Later they were transplanted to their permanent position, ten trees of each being set at the station farm at Mt. Carmel, near New Haven, and 75 of each on the upland near Portland in the central part of the same state. With these, in each location, were set a like number of trees of *C. speciosa* which were started one year later. It is unfortunate that these were not started at the same time, but they afford some comparison.

VIGOROUS GROWTH OF THE HYBRID

As can be seen in Table I, the plants grew vigorously. During the summer of 1915, the plants at Mt. Carmel were severely damaged by wind, the branches being badly broken, particularly those of the cross, as it was growing the most rapidly. Consequently, in order to have them start even again, it was

Table I.—*Height of Catalpa Bignonioides, of C. Kaempferi, of Their Hybrid, and of C. speciosa (average, in feet, of ten trees grown, at Mt. Carmel).*

Year	Age	*C. bignonioides*	*C. bignonioides* * *C. kaempferi*	*C. kaempferi*	*C. speciosa*	
1912	1	0.2	0.4	0.2	1913	0.8
1913	2	1.5	2.3	0.8	1914	2.2
1914	3	3.7	4.9	2.6	1915	6.9
1915*	4	9.9	8.7	5.7	1916	9.2
1916	5	7.4	9.3	5.8	1917	10.5
1917	6	10.3	11.3	8.2	1918	11.2
1918	7	11.4	13.1	9.1	....	....

* Trees severely damaged by wind breakage so that all plants were cut to the ground and only one sprout allowed to grow the following year.

decided to cut the trees to the ground before the following growing season. It is the usual practice with catalpas, when they are grown for timber,to cut them back after one or two years as the trunks are then straighter and the trees make fully as much growth in the end as when they are not cut back. Afterwards the trees were limited to one sprout.

The greater growth of the hybrid was easily apparent after the trees were well started, as shown by the figures in the table and the trees shown in Fig. 7. The increased vigor of the hybrid is even more than that indicated by the figures. The larger parent at Mt. Carmel, *C. bignonioides*, did not flower until 1918, and then produced only a few pods on one or two trees. The Japanese species flowered in 1915 and every following year. The cross likewise flowered with it. In addition, therefore, to making a larger vegetative growth, the cross has expended energy each year upon seed formation, which the larger parent has not done to any appreciable extent. In the profusion of its bloom and the abundance of seed this cross is a remarkably fine illustration of the vigor frequently derived from species hybrids. In amount of seed produced, it is from five to ten times more productive than either parent, a notable instance of the temporary advantage given to some crosses in natural competition.

As grown at Mt. Carmel, in the southern part of the state, both parents and their offspring have proven to be perfectly winter-hardy. At Portland, about 30 miles north, the *bignonioides* parent has suffered severely. During the latter years it has been killed to the ground every winter, growing from the base each spring in a mass of sprouts. The Japanese parent and the cross have so far been unharmed. Although the distance is small between these two localities, it should be remembered that one passes from one biological zone to another (Upper Austral to Transitional) in going from Mt. Carmel to Portland, Conn. The advantage which the hybrid has over both parents is consequently much accentuated as *C. Kaempferi* is naturally a small grower. The combination of the two species, possessing the larger growth of one parent together with the greater viability of the other, far surpassed either parent in this location.

INHERITANCE OF PARENTAL CHARACTERISTICS

The detailed characteristics of each parent, and the way they are expressed in the hybrid, are arranged in Table II. There is an intimate mingling of the features of both parents, so that this plant affords a good example of a species cross of the type studied with so much interest by the early hybridists such as Kölreuter, Gärtner, Focke and others. It is not strange that investigators, working with such material as this, did not make much progress in arriving at any definite principles of heredity While some characters in this illustra-

REPRESENTATIVE TREES AFTER SIX YEARS OF GROWTH

A good illustration of vigor in a tree hybrid (second from left) combining features of both its parents—the small Japanese catalpa *C. Kaempferi* and the native *C. bignonioides* on either side. C. speciosa is shown at the extreme right for comparison. (Fig. 7.)

tion are expressed in an alternative fashion, the hybrid is intermediate for the most part. In every part of the tree contributions from both parents can be made out. This is shown very clearly in the leaves. The oriental catalpa is finely pubescent on the upper surface, the leaves having a velvety feeling, but are entirely smooth on the lower surfaces. The native tree is the reverse of this, being glabrous on the upper surface and hairy on the lower side of the leaves, with rather coarse filiments, especially on the veins. The hybrid, however, resembles both parents in these respects, the leaves being velvety on the upper surface and hairy on the under sides, the latter, sparingly however, and only on the young leaves.

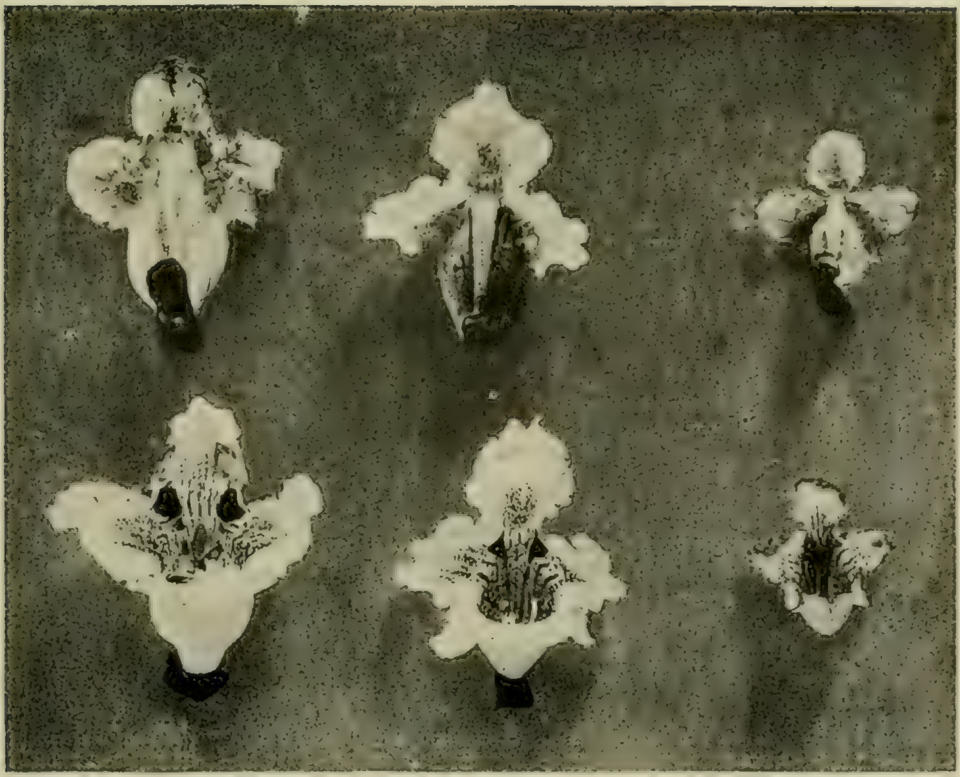
In the same way, one can trace the other characters and find some influence of both parents on the hybrid in nearly every part of the tree. On the other hand, in the nature of the bark, the margin of the leaves, the coloring in certain parts of the leaves and flowers, the inheritance is definitely alternate, the features of one parent in some parts, and of the other parent in other parts, being predominant upon the product of their union. In dimensional characters the hybrid is intermediate except in those parts which are affected by vigorous development such as height of plant, diameter of trunk, size of leaves and inflorescences. In these the hybrid clearly excels its parents. It is interesting to note that the size of cells, as shown by tracheid length, at least, is the same in both parents and the cross

INFLORESCENCE OF DIFFERENT SPECIES COMPARED

The inflorescence of the hybrid, shown in the center, is larger than that of either parent, *C. bignonioides* at the left and *C. Kaempferi* at the right. (Fig. 8.)

TABLE II.—*Comparison of the First Generation Hybrid of Catalpa Bignonioides by C. Kaempferi with Its Two Parent Species.*

	C. bignonioides	*C. bignonioides* *C. kaempferi*	*C. kaempferi*
Bark	Rough	Smooth	Smooth
Leaf, upper surface	Glabrous	Pubescent	Pubescent
lower surface	Hirsute	Sparingly hirsute on young leaves.	Glabrous
shape	Generally ovate	Generally cordate	Generally cordate
margin	Entire	Three-lobed, rarely entire.	Three-lobed, rarely entire.
Petiole	Slightly colored only on young leaves.	Colored	Deeply colored
Insertion of petiole	Uncolored	Colored on young	Colored on all leaves.
Notches in veins	Uncolored	Uncolored . . . [leaves]	Colored.
Flower, color	White with brownish-purplish spots and orange stripes.	White with brownish-purplish spots and orange stripes.	Pale yellow with brownish-purplish spots and dark yellow stripes.
length	3 to 3.5 cm	3–3.5 cm	2 cm.
breadth	3 to 3.5 cm	2.5–3 cm	2 cm.
Pods, length	30 to 35 cm	20 to 40 cm	20 to 30 cm.
breadth	1 to 1.5 cm.	.5 to 1 cm	.3 to .5 cm.
Seeds, length	2 to 2.5 cm	2 cm	1 cm.
width	.7 to .8 cm	.3 to .4 cm	.2 to .3 cm.
hair length	2 cm	1.5 to 2 cm	.7 to .8 cm.



INDIVIDUAL FLOWERS OF THE CATALPA SPECIES

The flowers of the hybrid are somewhat narrower than those of the larger flowered parent but are similarly white in the ground color, while the other parent is yellow. Likewise in the orange color of the large stripes the hybrid resembles *C. bignonioides*, as the small flowered parent has dark yellow stripes. (Fig. 9.)

In addition to being resistant to low temperatures the combined plant is less affected by the leaf spot, *Macrosporium catalpae*, E. & M., which attacks all catalpas, but, as observed, the spotting of the leaves has been much more severe on C. *bignonioides* than on the other parent and the cross. Perhaps there is some relation here to the pubescence of the leaves.

PRACTICAL USES OF THIS TREE

The value of the hybrid, in its more rapid growth, greater hardiness and profuse blooming, recommends itself to the landscape gardener. The flowers are not difficult to manipulate and each pod contains a large number of seeds, so that it is quite feasible to produce the first generation crossed trees for use as ornamental plantings. As a timber tree, it is rather doubtful whether the hybrid has a sufficiently greater growth than *C. speciosa*, the tree usually grown, to warrant its production for that purpose. However, a catalpa grove is a fairly permanent investment, the trees growing up from the stumps after each cutting, thereby extending the usefulness of one planting over a long period of time, so that considerable expense in obtaining the seed might well be justified. Therefore, it would be well worth while to try this hybrid in those localities where catalpas are more extensively grown for posts and ties.

The seeds produced by the hybrid trees are well developed and are fertile. A sample tested in the incubator gave 51 % viability. None of the second generation plants have been grown from this

cross. Sargent speaks of their reverting to Kaempfer's species in flower color. It is of course to be expected that they will show segregation. It is quite possible that something in the way of a new catalpa of value can be fixed from this cross. It would be a matter of growing a large number of seedlings and selecting for several generations. The trees flower young, so that this would not be as hopelessly slow a proposition as with most trees. Since the history of many valuable plants points clearly to their hybrid beginnings, it seems well worth continuing this hybrid into later generations. The likelihood of obtaining anything of value would depend largely upon the number of trees grown. For this reason the Connecticut Station would be glad to furnish almost any quantities of seed from the first crossed plants, which would give the segregating generation, to anyone who would be interested in growing them. The trees require little attention after they are once started, and in many places catalpa growing has proven to be a profitable commercial venture. The segregating generation would not give as uniform a tree as the pure species and probably would not be so profitable to grow, but might ultimately produce a new tree of real merit. In view of the results secured from this cross, other crosses of these two species with *C. speciosa* would be worth trying.

Since the hybrid artificially produced from *C. bignonioides* and *C. Kaempferi* coincides with the natural hybrid described under the name of "Teas' hybrid catalpa," and therefore confirms its assumed parentage, this fact lends considerable probability to other cases of hybrid trees whose ancestry can be no more than guessed at by a comparison of the characters of the new form with its possible parent species.

As an illustration of hybrid vigor, it is one more to be added to the long list of augmentations of growth immediately resulting from crossing. In this case it is particularly easy to see how many superficial features have been contributed by both parents, and this may be taken as one indication that the greater size and hardiness possessed by the hybrid is similarly due to the combined action of favorable growth factors contributed by compatible but diverse parents.

LECTURES ON HEREDITY AND SEX (delivered in Glasgow, 1917-18), by F. O. Bower, J. Graham Kerr, and W. E. Agar. Pp. 119, with 46 illustrations. London: Macmillan & Co., Ltd., 1919.

The authors announce that they have tried "to convey in as simple terms as possible the leading facts relating to Sex in Animals and Plants, together with suggestions bearing on the use and effect of sexual propagation." The evolution of sex is taken up at some length. Heredity is disposed of in a conventional manner with a brief account of Mendelism and a more extended discussion of correlations between parent and offspring. The book contains many sound suggestions, but is probably too detailed and technical for the ordinary reader, while for the serious student the absence of references will be a drawback.—P. P.

SEX CONTROL, by John William Conway. Pp. 118. Kansas: The Norton Champion, 1919.

Mr. Conway, who is apparently not familiar with the large amount of careful work that has been done during recent years on the problem of sex control, has brought together a confused mass of information, which he first published in his local weekly newspaper. The two tangible theories which he espouses are the time-honored ones that (1) the offspring is of the sex of the weaker or less passionate parent, and (2) that the offspring is of the sex of that parent which is best nourished. Mr. Conway makes no attempt to reconcile the contradictions of these two theories, and he also drags in prepotency, atavism, and various other more or less mystical ideas, to complicate the situation still further. No new evidence of value is included in support of his thesis.—P. P.

SOME PROMISING NEW PEAR STOCKS

Beverly T. Galloway

Office of Foreign Seed and Plant Introduction, Washington, D. C.

PRACTICALLY all of our important cultivated fruit crops, the apple, pear, plum, cherry, peach, prune, apricot, and nectarine, are in a sense parasites, for they must get their life and sustenance from special roots selected and provided by man. These roots are known as stocks, and millions of them are imported every year and used by nurserymen in the conduct of the largest business of its kind anywhere in the world. There are between five and six million acres of bearing apple, pear, and cherry trees in this country, and all but an insignificant portion are being fed and supported by roots having their origin in far-away France or Italy.

We are interested at this time in pear stocks, stocks coming from free-seeding, stabilized species; stocks that will grow vigorously throughout our principal pear-growing sections; that may be economically and easily produced by nurserymen; that will not leaf-blight; that are highly resistant to fire-blight; that will produce a large percentage of No. 1 trees in the nursery; that may be budded any time from June to September, and that will give a long-lived tree.

WHY NEW TYPES ARE NEEDED

During the past fifteen years the Office of Foreign Seed and Plant Introduction, in the United States Department of Agriculture, has introduced a good many pears—somewhat over 350, in fact. During the past two years special attention has been given to a restudy of these introductions with a view to ascertaining their value: (1) for stocks; (2) for breeding purposes, that is, their use as a means of securing, through breeding, new types of pears; and (3) their use and value as new or fruiting types just as they were introduced.

The number of pear trees of all ages in this country is probably not far from twenty-five million. The total acreage and production of pears has remained more or less constant for the past eight or ten years. While the acreage and production have remained constant, this is only made possible by extensive new plantings each year. Fire-blight is the great bane of the pear in this country. From four to five million young trees must be raised each year to meet the losses caused by fire-blight and the normal increases of orchard extension. Fully 90% of all our pear trees are grown on French seedlings. The production of these seedlings from the common wild pear, *Pyrus communis*, has long been an important horticultural industry in France.

No systematic attempt has been made, so far as we are aware, in this or any other country to secure new types of pear stocks suitable for special needs and particular places. Nor has any serious attempt been made to study the larger question of *congeniality*. We know that the same variety of pear behaves differently on different types of stocks. These differences are more marked in the case of different species, but they are also noticeable where seedlings of the same species are used. Much work, therefore, remains to be done to find the best stocks for particular varieties of our cultivated pears and stocks best suited to particular regions, soils and climates.

CHINA'S ABUNDANT STOCK MATERIAL

The Orient, and particularly China, seems to offer the most fruitful field for new pear stocks. China is pecu-

THE USURI WILD PEAR, PYRUS USURIENSIS, FROM CHINA

This wild pear grows abundantly in China, Korea, Manchuria and Siberia. In the United States it has proved to be a very slow grower, and of doubtful value as a stock. Budded August 1; photograph August 14, 1919. (Neg. 25436.) (Fig. 10.)

THE KUAN LI, OR CHINESE WATER PEAR

This is a cultivated form of the Usuri pear, and is a very promising stock. Compare the growth with that shown in Fig. 10 above. Within a year or two, it is expected that seed of this valuable type of pear can be furnished from the government plant station at Chico, Cal.; budwood can be secured at an early date. The above photograph made Aug. 14, 1919. (Neg. 25425.) (Fig. 11.)

THE CHINESE SAW-LEAVED PEAR, PYRUS SERRULATA

A very promising stock. It is a strong grower and has good foliage, comparing favorably with the Kuan li. This photograph (Aug. 14, 1919) was made of some discarded spec mens, all the good plants having been cut off to save the buds. (Neg. 25441.) (Fig. 12.)

THE BIRCH-LEAVED PEAR, PYRUS BETULAEFOLIA

This is a vigorous grower and free from leaf blight. Compare these with Fig. 14 on page 30, which shows some Japanese seedlings almost completely defoliated by leaf blight. Photograph Sept. 11, 1919. (Neg. 25482.) (Fig. 13.)

liarly rich in distinct species of pears, and we should look to these wild species, rather than cultivated varieties, for our best stock material. The most extensive work on pears with particular reference to the securing of stocks, resistant or immune to fire-blight, has been done by Mr. F. C. Reimer, of the Oregon Experiment Station. Mr. Reimer began his work five or six years ago and has assembled probably one of the largest collections of pears in the world. The special pear station located at Talent, Ore., where Mr. Reimer is conducting his investigations, is one of the great pear-growing sections of the United States. This is in the Rogue River Valley. Fire-blight is very destructive in this valley and at other places on or near the Pacific coast. The blight frequently attacks the bodies or trunks of the trees, and it was largely to meet that situation that Mr. Reimer inaugurated a line of work, having for its primary object the discovery of types that would give a blight-resistant root and body upon which the susceptible tops could be worked. It is believed by Mr. Reimer that if blight-resistant or blight-immune trunks could be secured, the disease might be held in check among the branches by rigid attention to surgical and antiseptic methods. Mr. Reimer's valuable work is still in progress, and he is now on a second trip to the Orient for the purpose of securing new facts and new pear material.

THE WORK OF FOREIGN EXPLORERS

We are indebted to two agricultural explorers for the larger number of pear species and varieties now at our disposal for study, testing and trial. The late Frank N. Meyer, of the Office of Foreign Seed and Plant Introduction, and Mr. E. H. Wilson, of the Arnold Arboretum, have rendered horticulture incalculable service in supplying material that has already proved very promising. Mr. Meyer's collections are quite extensive and have been widely disseminated. Beginning in 1905 and continuing until his death in 1918, Mr. Meyer collected and sent in more than 125 separate and distinct lots of pears. This represents probably fifteen or twenty species and twenty-five to thirty varieties. A good many of Meyer's pears are assembled at the Chico, Calif., Field Station of the Office of Foreign Seed and Plant Introduction. Quite a large collection of Meyer's and other pear introductions have been brought together and are now being grown at the Yarrow Field Station near Washington, D. C.

Mr. Wilson began his work on pears more than a dozen years ago and, under the direction of Dr. C. S. Sargent, of the Arnold Arboretum, has assembled a fine collection of oriental and other species at the Arboretum near Boston, Mass. The following notes are based chiefly on field studies and tests at our field stations and work in cooperation with nurserymen and others:

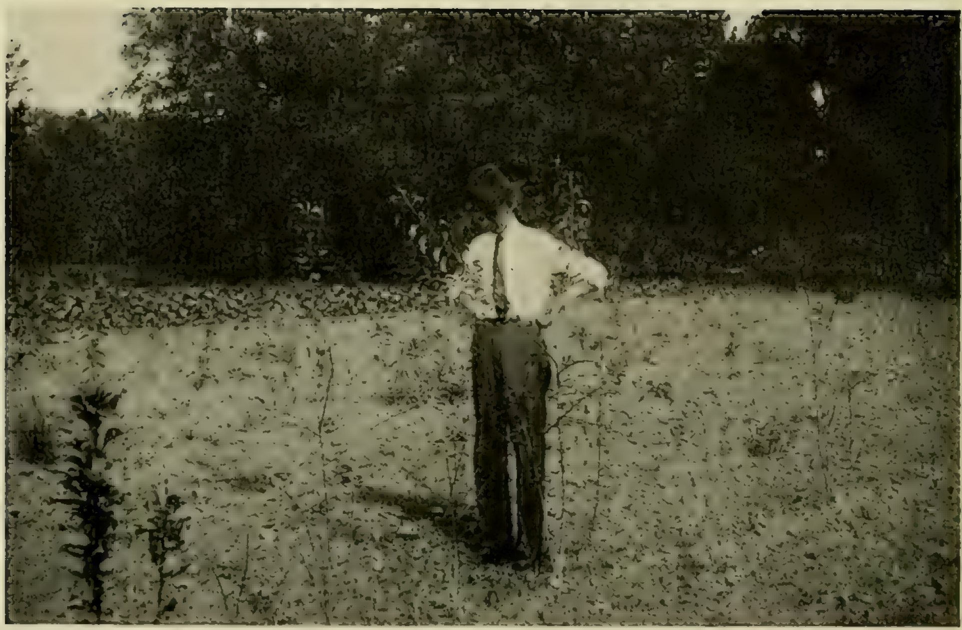
The Usuri Wild Pear, Pyrus ussuriensis, S. P. I. No. 44237 (see Fig. 10).—This wild pear, first found along the Usuri River, north of Korea, has been known to botanists for more than fifty years. It has a wide range, having been found in numerous places in Korea, China, Manchuria and Siberia. Meyer reported it in great abundance from Chihli Province, north of Pekin, in 1907. In 1916 he revisited the region and found many of the trees of this wild pear had been cut down and Indian corn or maize was being grown in their place. Wilson found the pear growing abundantly in northern Korea. The experiments made by Reimer with seedlings of this pear gave much encouragement at first, for they proved to be very resistant to fire-blight. With us it has proved a very slow grower, rather subject to leaf-blight, and therefore unable to hold its leaves during the budding and propagating season. We can hardly class this pear as a promising new stock. Our object in introducing it here is a precautionary one. The pear has been considerably exploited as a stock. Seed is being offered, and aside from the question of the authenticity of the seed, there is the broader problem of the actual value of the seedlings for

stock purposes. Fig. 10 shows the habit of the seedlings in the nursery row. We have budded eight or ten of our principal varieties of pears on this stock. Not more than 30% of the buds took. The bark is tough and frequently refuses to "slip" easily. In striking contrast there is shown in Fig. 11 a cultivated form of the Usuri pear found by Meyer in 1917, in the Chihli Province, China.

Kuan li or *Chinese Water Pear*, S. P. I. No. 44235 (see Fig. 11).—This pear unquestionably belongs to the Usiuriensis group. Meyer reported it as having small fruits flattened somewhat like an apple and of a rusty, greenish color. He sent in but one lot of seed of 17 ounces. From these seeds several thousand seedlings have been grown and tested as stocks at several places. Our first tests were with grafted stocks. All the pears worked on this stock, including Bartlett, Clapp's Favorite, Anjou, Dutchess, Lawrence, Seckel, Sheldon, Howell, Clarigeau, and others, are doing very well in the nursery row. Unfortunately, the source of further seed supply from China is doubtful. In the maze of Chinese pears it is questionable if anyone except an expert could relocate the type from which Meyer obtained his original supply of seed. In order to preserve this valuable type of pear we have had top-worked, at the Chico, Cal., Station, a part of an old pear orchard to the Kuan li, and within a year or two we should be getting seed from this source. We shall also be prepared at an early date to furnish budwood of this pear to those who may desire to propagate it for seed production. We place the Kuan li as one of our most promising pear stocks.

The Chinese Saw-leafed Pear, Pyrus serrulata, S. P. I. Nos. 34567 and 45832 (see Fig. 12).—This pear, first collected by Wilson in 1907 in the Hupeh Province, 800 or 900 miles west and south of Shanghai, was again found by Reimer near Ichang, China, in 1917. Ichang is in Hupeh Province. Reimer found the pear about 15 miles northwest of Ichang at elevations from 3,000 to 3,700 feet. Its growth in the nursery compares favorably with the Kuan li. It is affected but slightly with leaf-blight, holds its foliage well in our hot summers, and has a long budding season. Our plants are from seeds sent by Mr. Reimer. The species does not appear to be common, and for this reason, if it should prove on further trial to be a useful stock, sources of supply should be established here. Authentic seed may be obtained from the Arnold Arboretum, but the supply there is naturally limited. We shall be in position to supply budwood in limited quantities from our collection. Buds from our principal varieties of pears worked upon this stock took well. It is too early to determine the value of the stock in producing an ideal nursery tree.

The Birch Leaf Chinese Pear, Pyrus betulaefolia, S. P. I. No. 21982 and other S. P. I. Nos. (see Fig. 13).—This pear has come to the Office of Foreign Seed and Plant Introduction from a number of places and has been listed under several S. P. I. numbers. Meyer collected it several times and Reimer sent in seeds of it. According to the late Jackson Dawson, it came to the Arnold Arboretum from the mountains near Pekin, China, in 1882. Fine specimens are now growing in the Arboretum. The tree occurs in many parts of China, and supplies of seeds for commerical purposes would not be difficult to get. Reimer reports it as being more or less susceptible to fire-blight. In the east we have never seen it blighted. No attacks of blight, so far as we are aware, have appeared on the trees at the Arnold Arboretum, and these are now more than thirty years old. The tree has proved practically free from leaf blight. It is a vigorous grower and is capable of being budded any time from July to the middle of September in the region around Washington. According to Reimer it is extensively used in China as a stock, where it is readily grafted, making a good union and producing vigorous trees. The pear can be readily grown from cuttings. Fig. 13 shows the re-



ORDINARY JAPANESE PEAR SEEDLINGS

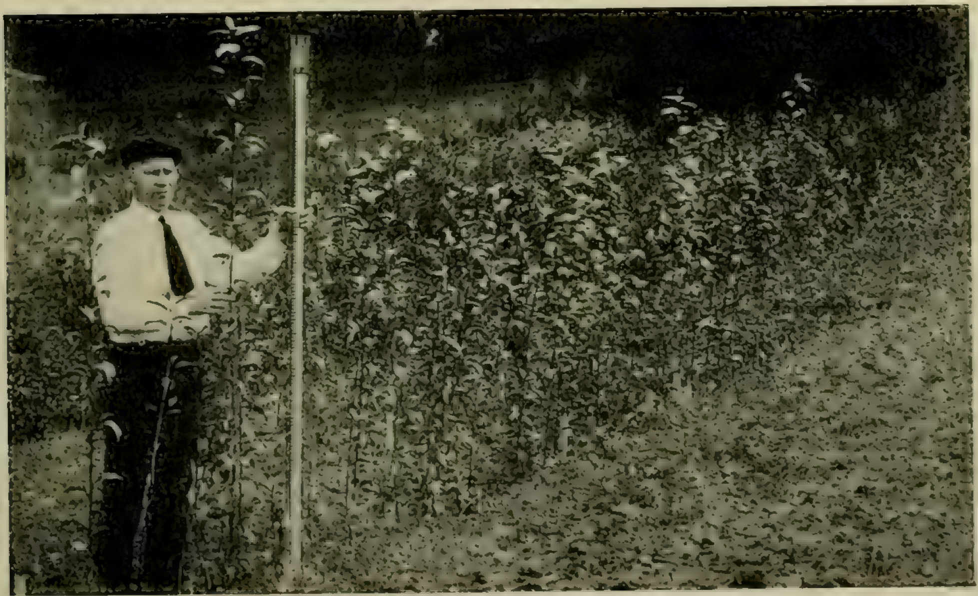
Pear seedlings such as are commonly used by nurserymen. These are badly leaf blighted and incapable of being budded. Photograph made Sept. 11, 1919. (Neg. 25484.) Compare this with Figs. 15 and 16. (Fig. 14.)

ORDINARY FRENCH PEAR SEEDLINGS

Millions of these are used for stocks in this country. They are weak growers and very subject to leaf blight. Photograph Aug. 14, 1919. (Neg. 25443). Compare this type with that in Fig. 16, a photograph made on the same day and at the same distance from the trees (Fig. 15.)

THE CHINESE CALLERYANA PEAR

This is the most promising of all the Oriental species. It is a fine grower and can be budded from July to September. Compare it with the French stocks (Fig. 15). Cooperative planting of trees for seed purposes is now under way to assure a home-grown supply of this remarkable species. Photograph Aug. 14, 1919. (Neg. 25437.) (Fig. 16.)



USE OF THE CALLERYANA PEAR AS A STOCK

Roots of this stock were grafted with a cultivated pear in the spring of 1919, and the above photograph was taken August 14, 1919. In three and a half months the growth was nearly six feet. The variety is a new pear supposed to be a cross between Keiffer and La Conte. (Neg. 25426.) (Fig. 17.)

markable manner in which this pear holds its foliage. The photograph was taken on September 11, 1919. At this time the leaves on the Japanese seedlings (see Fig. 14) and the French seedlings (see Fig. 15) were practically all off, largely as a result of the attacks of the leaf blight fungus, *Entosporium maculatum*.

The Chinese Calleryana Pear, Pyrus calleryana, S. P. I. No. 44044 and other S. P. I. Nos. (see Fig. 16).—Of all the pears tested and studied this remarkable Chinese species holds out the greatest promise as a stock. The tree has a very wide range in China, and several distinct types have already appeared. It has stood some very severe winters during the past twelve years at the Arnold Arboretum. It grows and thrives luxuriantly at our Field Station, Brooksville, Fla., where it is almost an evergreen. One of the last important pieces of work of the late Frank Meyer was the collection of more than 100 pounds of the seed of this pear in the mountains in and around Ichang, China. After many trials and heart-breaking delays, Meyer got the seed to us, but before it could be put in the ground his body was floating in the great Yangtze River, that giant of waters which for centuries has taken its human toll. Alone for months, with many dangers around him, he wrote:

"I am sitting now in a Chinese house, for the inn I lived in at first was too noisy and dark, and there was no room to dry seeds or specimens. Some mice are running about, mosquitos buzz, a cricket sings in an old wall, and the policeman who is stationed to spy upon me snores on the bench, for it is well into the night. Tomorrow we may go to see a lot of pear trees 15 miles from here."

All who have tested the Calleryana pear as a stock, report favorably upon it. It is a vigorous grower under nearly all conditions. It holds its leaves well, and it can be budded any time from July 1 to September 1. All of our best kinds of pears so far tried take well upon it. The seedlings are easily grown and, when from pure types, run remarkably uniform. Commercial supplies of the seed are not yet available, but it is believed that considerable quantities can be obtained through one or two reliable sources in China. Meanwhile it is important to assure ourselves of a home-grown supply of this most promising species. To this end coöperative planting of trees for seed purposes, and coöperative efforts in top-working other trees with the Calleryana species are under way. Wood is now available for the latter object. The remarkable uniformity and vigor of the seedlings are shown in Fig. 16. This picture was taken August 14, at which time most of the French seedlings (Fig. 15) were entirely defoliated. Fig. 17 shows the growth of spring-made grafts on this stock. The variety is a new pear supposed to be a cross between Kieffer and La Conte. The grafts were put out May 1 and the photographs taken August 14, three and a half months later. By October 1 these grafts averaged 7 feet in height.

Summarizing, it may be said that the prospect of finding new and valuable pear stocks among the oriental wild species seems very good. What the ultimate life of our principal varieties of cultivated species on these stocks may be remains to be determined. This is a long-time problem. Already there is sufficient encouragement to go forward with the work in the hope that we shall eventually not only be able to produce all of our own stocks but produce them, having all the desirable characteristics set forth at the beginning of this paper.

THE DECLINE OF AUTOCRACY AND ITS RELATION TO WARFARE

A Look into the History of the Last Five Centuries—Autocracy Associated with Wars—Tendencies toward Democracy in Development of Modern Civilization

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CAN war be abolished? Will autocrats disappear? Are democracies less prone to warfare than are other forms of government? To what extent have the great tyrants of the past been responsible for the warfare that has been waged? These are some questions to which we would like an answer.

Without supposing that history can positively answer these questions, it is justifiable, considering the importance of the subject, to seek what light we may; and so it is interesting to make an appeal to the extended records of the past and see if there is any evidence that autocrats have been long disappearing, or that they have been a predisposing cause of war. It will doubtless be of welcome interest to many persons to know that history's answer to both of these questions is in the affirmative. European autocrats have been decreasing numerically ever since the twelfth century—those of the more powerful sort since the sixteenth.

In regard to their relation to war, it is highly probable that states of warfare, whatever be their cause, are especially favorable to single-handed governance. Therefore we ought not to say that great autocrats are here shown to be a cause of war, though very likely to a considerable extent they may be; but at least we have evidence that the two are associated. This is proved by an analysis of the history of eleven European nations. The nations include Austria, Denmark, England, France, Holland (or the Netherlands), Poland, Prussia, Russia, Spain, Sweden, and Turkey. The period covered extends from the present day to as far into the past as records are available. For most of these countries, however, it is not practicable to carry such a study back of the sixteenth century. For England and France the records enable us to extend the research to the beginning of the twelfth century.

YEARS OF WAR

It would of course be of added interest if something more than the mere years of war and years of peace could be discussed, since it may be that great wars were more associated with autocrats than were small wars, but in the absence of sufficient data there can be no harm in first making the simple analysis and answering the question: Are autocracies especially associated with periods of war? Any book of dates concerning periods of war will conflict somewhat with any other book, since a certain amount of personal judgment necessarily enters into any compilation. Sometimes it is hard to tell a war from a riot. More often it is hard to tell just when a war begins and ends. Mr. Alexander Baltzly compiled under my direction, and in association with the Department of Government in Harvard University, a complete list of all European wars of modern times. This was published in 1915. It was put together just prior to the late war with the hope of throwing light on the question whether there was any evidence that wars were tending to disappear. This book, "Is War Diminishing?" is, as far as I know, the only source of appeal for a comprehensive study of European wars. Some special studies concerning the wars of single

nations have been published, but these are detailed and isolated—often mere propaganda. In Mr. Baltzly's lists we have an excellent basis for making a first approximation in the study of the causes of war, since the greatest effort was made to cover the ground completely, and, moreover, as the compilation was made without having the present research in mind, its errors should cause no bias.

A LIST OF AUTOCRATS

The next question is: Whom shall we include in a list of the great autocratic rulers of recent times? Here, again, it is necessary to be systematic and to overlook as few examples as possible. Some sort of a check-list is essential. Such a list is, as far as sovereign rules are concerned, already published, and is to be found in the appendix of my "Influence of Monarchs" (1913). It was formulated for another research, namely, to measure the magnitude of the personal influence of one recurring historical type, and the very fact that it was made for another purpose makes it all the better as a basis for the present discussion.

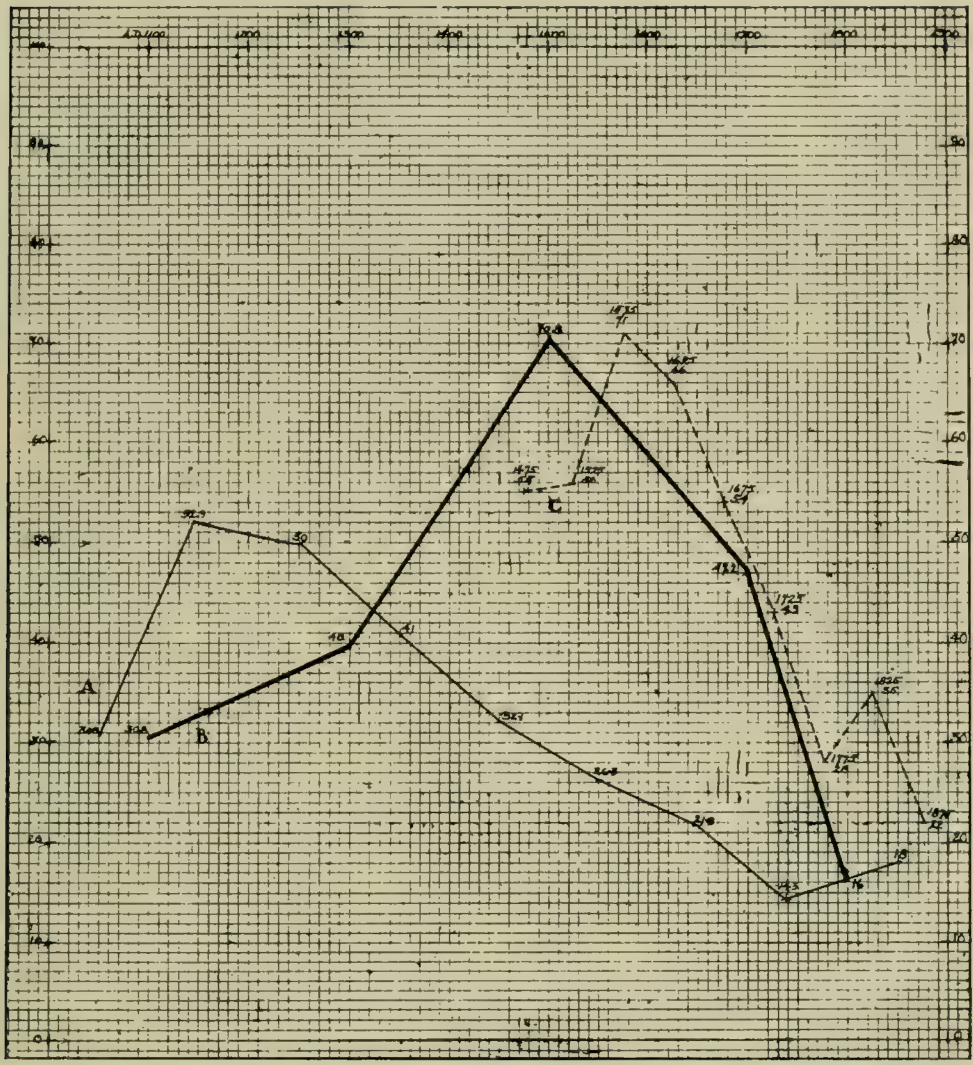
From this list of sovereigns I first picked out all those who undoubtedly should be rightly designated by the word *autocrat*: that is, those who were autocratic not only by nature, but also actually were able to act in an autocratic manner. To these I added a few doubtful names,—sovereigns who wished for personal control but who did not very well succeed in attaining their ends.

Names taken from the history of these same European countries from the French Revolution to the present day, and also from the history of the old kingdom of Poland, were added to the list in order that the periods covered in "Is War Diminishing?" should be completely included here. This produced a total of about 120. These were then roughly graded in an order of eminence and in the following manner: Mr. T. Lothrop Stoddard, Mr. Alleyne Ireland and myself each chose separately the names of: First, the ten seemingly greatest autocrats; second, the twenty greatest; and third, the sixty or leading half of the whole. I have now extended this to 100 names and arranged the first sixty in the order of their autocratic greatness on the combined basis of our separate ratings. In the lower portion of the list the order of position means but little, but in the upper part the differences are more clearly marked and are also more important in leading to significant conclusions. Probably the first ten or twenty names are not very different from those that would, perforce, be chosen by anyone conversant with European history if the test were to be, as it here is, the grading of autocrats according to the vastness of their whilom rule and the extent of their individual domination, not necessarily according to their intellectual gifts.

The following twenty monarchs are given in their order of eminence judged solely as great autocrats: Napoleon, Frederick the Great, Peter the Great, Selim I of Turkey, Suleiman the Magnificent, Ivan the Terrible, Louis XI of France, Philip II of Spain, Louis XIV of France, Catherine II of Russia, Charles XII of Sweden, Charles V (the Emperor); Gustavus Adolphus, Philip Augustus, Louis IX of France, Henry VIII of England, Ivan III of Russia, Henry IV of France, William II (the late Kaiser), the Great Elector of Brandenburg.

It must not be thought that the order within the group is important, or that there is any intention of conveying the idea that each one of these persons whose name appears ahead of some other person is known to be a greater autocrat. Every reader through personal preference would rearrange this list; but any rearrangement within the first ten, or within the second ten, would make no difference. If many were transferred from high to low positions, or if great changes of inclusion and exclusion were made, then important differences in the conclusions might result. It seems unlikely that such wholesale changes could be justified.

A list is here given of the 62 sovereign



HISTORY OF AUTOCRATS AND WARS AS TOLD BY A DIAGRAM

A. Showing the decline of all autocrats.
B. Showing the rise and decline of the twenty greatest autocrats.
C. The dotted line shows the decline in percentage of war-years per century. (Fig. 18.)

rulers who have been selected as especially representative of autocratic sway (see Table I). The first 30 are given ranking numbers, though, as before stated, this must be considered only as tentative and approximate. That this arrangement in a series has a value seems to be interestingly illustrated in this research, for, if the sovereigns had not been individually graded, the discovery would not have been made that European history furnishes actual evidence that great autocrats are especially associated with periods of warfare.

If we consider only the evidence drawn from the entire 62 autocrats, we find 914.5 years of war out of a total of 1,779 years of reign. This is 51.4% and is only slightly greater than the

TABLE I.—*Leading Royal Autocrats of Europe*

	War years	Total	Years of reign
Austria:			
26 Maximilian	17.0	26	1493–1519
12 Charles V	0.0	2	1519–1521
22 Maria Theresa	16.0	40	1740–1780
Francis Joseph	8.5	68	1848–1916
	41.5	136	
Denmark:			
Christian II	6.0	10	1513–1523
Christian IV	22.0	52	1596–1648
	28.0	62	
England:			
Henry I	25.0	35	1100–1135
Henry II	6.5	35	1154–1189
Richard I	7.0	10	1189–1199
25 Edward I	16.5	35	1272–1307
Edward III	33.0	47	1330–1377
Henry V	6.0	9	1413–1422
Henry VII	5.5	24	1485–1509
16 Henry VIII	12.0	38	1509–1547
23 Elizabeth	39.0	45	1558–1603
	150.5	278	
France:			
Louis VI	20.0	29	1108-1137
14 Philip Augustus	25.0	43	1180–1223
15 Louis IX	11.5	34	1236–1270
Charles V	12.0	16	1364-1380
7 Louis XI	6.0	22	1461–1483
Anne, Regent	1.0	8	1483–1491
Catherine de Medici	4.0	11	1560–1571
18 Henry IV	10 0	22	1588–1610
9 Louis XIV	34.0	54	1661–1715
1 Napoleon	10.0	10	1804–1814
Napoleon III	11.5	18	1852–1870
	145.0	267	
Holland:			
27 William the Silent	9.0	9	1575–1584
Maurice	25.0	41	1584–1625
Frederick Henry	22.0	22	1625–1647
William II	1.0	3	1647–1650
William III	17.5	30	1672–1702
	74.5	105	
Poland:[1]			
Casimir IV	23.5	45	1447–1492
Sigismund I	20.5	42	1506–1548
Stephen Bathory	3.5	11	1575–1586
John III	14.0	22	1674–1696
	61.5	120	
Prussia:			
20 The Great Elector	10.5	48	1640–1688
Frederick William I	5.0	27	1713–1740
2 Frederick the Great	11.0	46	1740–1786
19 William II	4.0	30	1888–1918
	30.5	151	

[1] Poland was not included in the Influence of Monarchs, nor was the history of any European country later than the Napoleonic period. Data from recent history have therefore been added.

Russia:			
17 Ivan the Great	24.0	43	1462-1505
6 Ivan the Terrible	32.5	37	1547–1584
3 Peter the Great	23.0	36	1689–1725
10 Catherine II	13 5	34	1762–1796
Alexander I	4.5	15	1810–1825
29 Nicholas I	29.5	30	1825–1855
Alexander III	0	13	1881–1894
	127.0	208	
Spain:			
21 Ferdinand and Isabella	17.5	25	1479–1504
Ferdinand	4.0	12	1504–1516
Charles V	25.0	39	1517–1556
8 Philip II	39.0	42	1556–1598
Charles III	2.5	29	1759–1788
	88.0	147	
Sweden:			
28 Gustavus Vasa	7.0	37	1523–1560
Charles, Regent	0.5	5	1595–1600
Charles IX	11.0	11	1600–1611
13 Gustavus Adolphus	13.0	21	1611–1632
Charles X	5.0	6	1654–1660
Charles XI	4.0	25	1672–1697
11 Charles XII	19.0	21	1697–1718
Gustavus III	2.0	21	1771–1792
Charles XIV	0	26	1818–1844
	61.5	173	
Turkey:			
30 Mohammed II	30.0	30	1451–1481
4 Selim I	7.0	8	1512–1520
5 Suleimani	36.5	46	1520–1566
Murad IV	17.0	17	1623–1640
Mahmud II	16.5	31	1808–1839
	107.0	132	

average number of years of war per century, as revealed by the tables in "Is War Diminishing?" which is 48.5. But if we consider only the 30 leading autocrats, we find that the average rises to 57.5 war-years per century, or 565.5 out of 983. For the leading 20 the average is 54.2, and for the ten greatest the average is 63.4 years of war per century. The totals here are 212.5 years out of 335. These figures are large enough to be significant. Here is shown a rise of roughly 50% for the most autocratic periods as against the comparatively non-autocratic periods, of which there are about 300, and whose war record must have been a little less than 48.5 years per century.

The true correlation between autocrats and war must be somewhat higher than is here indicated, since oftimes democratic nations have been unwillingly drawn into conflicts against autocracy, as was the case in the Napoleonic period and in the late World War. In this way non-autocratic periods must get more years of war than would have been the case if all countries had always been free from great autocrats.

WAR-YEARS UNDER DEMOCRACIES

If we turn to the other side of the question and study the democracies themselves, it appears that their periods occupied in warfare have been somewhat less in total duration than the average. There have not been many eras of real democracy in European history, but there have been times when nations have been more democratic than at other times. England has, for instance, been largely governed by the voice of the people during recent

generations. The same is true of many European nations during the nineteenth century. It is this century, and especially its last half, that shows the maximum years of peace.

If we take out for study all periods in which no monarch or regent is recognized as ruling and the nation is theoretically a "republic," "commonwealth," "consulate," or designated by some such word, we have a definite criterion for inclusion and can express our results numerically.

If we omit the doubtful "stadholdership" in Holland, we have in England the Commonwealth, 1649-1660, with 10 years of war out of 11. France had three republics and one consulate with 21 years of war out of 63. Holland had two republics (1759-1766 and 1795-1805) and The States which lasted from 1702 to 1747. During these eras it showed 35 war-years out of 84. Spain had two years of republic from 1873-1875. They were filled with internal warfare. Russia, since the overthrow of the Czar, has been in an almost constant state of either warfare or anarchy.

The total of all these years of democratic control is 163. The total years of war are 72. This is 44.2%. It is somewhat less than the total for all autocratic regimes, which was 51.4%. It is considerably less than the average for the first ten which was found to be 63.4. Furthermore, in the instances where the democratic forms of government have been associated with an extremely high percentage of warfare, these popular governments represent beginnings in this practice of political control. Also England during "The Commonwealth," with 10 years of war out of 11, was in reality under one of the greatest of autocrats, though a non-royal one.

There is some additional argument that democracies may be associated with an increased amount of peace from the fact that the comparatively democratic nations, Denmark, Switzerland, Sweden, and Holland, have been free from war during the last hundred years.

It has not been possible to include in this research non-royal autocrats like Cromwell and Richelieu. The difficulty would be in knowing when to stop, since no comprehensive list of such statesmen has ever been formulated. But the logical conclusion is that, if royal autocrats predispose towards belligerency, non-royal ones also do, and therefore some of the fighting periods now credited to comparatively non-autocratic governments should in reality be taken as exhibiting a further proof of the truth of the theory here set forth.

AUTOCRATS DIFFICULT TO ABOLISH

There seems, then, to be no doubt that great autocrats are associated with wars probably as a contributory cause. If they are a cause of war, the question then becomes one of vital interest: How are they forever to be abolished? This is not likely to be an easy matter. Autocrats work insidiously and, until they have become strong, they are not autocrats. By the time they have become autocrats they are then strong, and consequently difficult to deal with. There is much that is permanent in human nature that makes easy the development of autocratic sway. Man is a very exploitable animal, and it is a long time before he realizes that he is being made into a machine. By the time he has been made into a machine and is part of a greater machine—that is, precisely what he is then willing to be or indeed wishes to be—so who is to stop the process? It is only the outside and outlying nations that can do this by uniting for the common cause. This they do over and over again, and the force of numbers wins for a time until again in some unsuspected quarter another autocrat has welded together another machine.

False and weak autocracies, like that of George III, Louis XVI, and Nicholas II, may break from within, but the genuine and strong, such as are under the personal control of some one great leader, require outside interference, which only becomes united after the autocracy has indeed been formed.

All this may be in some measure explanatory or not; at any rate the fact is that, while European history has shown for the last eight centuries a tendency for autocrats to become less numerous, it has not shown the same tendency towards a disappearance of autocrats of the first magnitude, those whom we find especially predisposing towards war.

In the history of England and France autocrats can be studied from the eleventh century onward. These are countries that have developed democratic institutions. Let us see if there is evidence of a gradual decline in the numbers of autocratic sovereigns throughout the centuries. Adding the numbers from both these countries together, we get the series from the year 1000 to the year 1900 by centuries as follows: 2, 4, 4, 2, 3, 4, 2, 0, 2; that is, there were two autocrats in the eleventh century, four in the twelfth, etc. It can be seen that the left-hand half of this series is heavier than the right. The ratio of weight is 13.5 to 9.5. Here we have numerical proof that autocracy has declined in France and England. This is significant as far as it goes, though the numbers are small.

If, on the other hand, we turn to Russia, Prussia, and Austria, we do not find the same tendency towards a decline in the number of autocrats. Figures for the early history of these countries are not available, but the records from the beginning of the fifteenth century are complete. The totals for each century are, according to our chart, 4, 2, 3, 5, 5. In these countries, then, just the opposite has taken place from what occurred in England and France. The right-hand, or modern portion of this series, weighs against the left in the ratio of 11.5 to 7.5. Are these figures significant? They are quite as likely to be as the reverse figures, 13.5 to 9.5, which suggested a decline in autocracy in France and England.

Both numbers are necessarily small, as we are dealing with a matter where only a few examples can be cited; but the figures warn us against assuming that democratic tendencies are constant in their growth or that they are part of the development of modern civilization. Here are three great nations whose territories cover a large portion of Europe, whose vast populations, if judged by their achievements, have unquestionably, at least until recently, advanced, both intellectually and materially, since the beginning of the fifteenth century, yet autocratic governance has actually been growing.

An answer, much more definite than this, to the whole question of the magnitude and distribution of autocracies in European history is gained by an appeal to all available instances from the eleventh century onward. A table containing such statistics is here given (see Table II). It shows two facts clearly. First, that as far as *all* autocrats are concerned there has been, in recent centuries, a decline in their numbers, and, second, it shows that, as far as the greatest autocrats are concerned, the reverse process was in operation up to about the year 1600. Since that date, all autocrats, both great and small, have been losing ground. The figures form such a regular series that little doubt is left as to their significance. Compare the earlier and the later halves of the table. If the totals for the 100 greatest autocrats be considered, the four centuries and a half prior to the year 1450 furnish, as compared with the subsequent 450 years, autocrats in the ratio of 190.7 to 96.4, or practically twice as many. From this the ratios change in an almost perfect gradation. For the first 50 autocrats the ratios virtually balance, being 63.5 to 62.8. For the first 40 we find more in the latter than in the earlier period. The ratios are 55.1 to 40.8. These rise for the first 30, being 44.4 to 26.3, sink for the first 20, though they exceed the first 40, and in final confirmation we find the highest ratio for the first 10 or greatest autocrats still on the same side of the balance, being 15.9 to 8.6 in favor of the late period or right-hand half of the chart. In other words, compared with the 450 preceding years, the last 450 have produced nearly twice

Table II.—*Distribution of Royal Autocrats by Centuries.*

	1000–1100	1100–1200	1200–1300	1300–1400	1400–1500	1500–1600	1600–1700	1700–1800	1800–1900
1st 10	1	0	0	0	1	4	1	2	1
2d 10	0	0	2	0	2	3	1	2	0
3d 10	0	0	1	0	1	4	2	1	1
4th 10	0	1	0	3	1	0	1	1	3
5th 10	0	1	2	2	2	1	0	1	1
6th 10	1	1	0	2	2	0	4	0	0
7th 10	0	2	0	2	1	1	2	0	2
8th 10	1	0	2	1	5	0	1	0	0
9th 10	0	1	1	5	1	2	0	0	0
10th 10	1	3	2	1	2	0	0	0	1
1st 100	4	9	10	16	18	15	12	7	9

Percentages of Autocrats among All Royal Rulers

	1000–1100	1100–1200	1200–1300	1300–1400	1400–1500	1500–1600	1600–1700	1700–1800	1800–1900
1st 10	7.7	0.0	0.0	0.0	1.8	7.0	1.9	4.1	2
1st 20	7.7	0.0	10.0	0.0	5.4	12.3	3.6	8.2	2
1st 30	7.7	0.0	15.0	0.0	7.1	19.3	7.3	10.2	4
1st 40	7.7	5.9	15.0	7.7	8.9	19.3	9.1	12.2	10
1st 50	7.7	11.7	25.0	12.8	12.5	21 1	9.1	14.3	12
1st 100	30.8	52.9	50.0	41.0	32.1	26.3	21.8	14.3	18

as many autocrats of the first magnitude.

These are distinctively the autocrats who are associated with warfare, and so we see one reason perhaps why in recent centuries so much fighting has taken place. In our work, "Is War Diminishing?" the conclusion reached by Mr. Baltzby and myself was that there is proof for a decline in the number of war years in the last two centuries, but that the evidence was not sufficient for a sound generalization. That was for two reasons: First, because there was an increase from 1450 to 1600 and second, because the history of France and England, the only history that furnished data extending well into the past, did not sanction such a generalization. There was no general or constant decline in war-years. The first four centuries showed no more war-years than the second.

GRADUAL ELIMINATION OF AUTOCRACIES

Although there has been no constant or gradual disappearance of war-years or of great autocrats as might be the case if these two dreaded things were being exterminated by the enlightening processes of education and civilization, there is nevertheless a way of looking at all the facts that presents an outlook not necessarily gloomy. The whole matter in a nutshell is this: There occurred during these nine hundred years one gigantic wave which reached its peak in the sixteenth century. The wave of autocracy corresponded with the wave of war, probably entirely, though a fragment of one of the curves is lacking or incomplete. We have no data for any early war periods (prior to 1450) except for France and England, but the probability is that the other nations were not excessively engaged in war during the twelfth, thirteenth and fourteenth centuries. This is suggested from the fact that, although small autocrats were numerous in these various countries, very great autocrats were not, and furthermore it is known that the war-years in these countries increased from 1,450 to 1,600. Also the high average of French and English war-years culminated in the sixteenth century.

Since this period, the downward slope of the wave has been marked for all degrees of autocracy. The reason why the second 450 years shows more autocrats of the greatest magnitude is because the sixteenth century falls in the second or modern portion. If we compare the last two centuries with the two preceding, we find the ratio-weights all heavier for the earlier period, as shown in the table 8.9 to 6.1; 15.9 to 10.2; 26.6 to 14.2, and 28.4 to 22.2, as we descend from the ten greatest to the forty greatest of the dictators. This is substantiated by a comparison of the three recent centuries with the three preceding, for again, the ratios are without exception heavier for the earlier period: 8.8 to 8; 17.7 to 13.8; 26.4 to 21.5; 35.9 to 31.3. Comparing these two sets of ratios, the conclusion is warranted that it is especially during the last two centuries that the decline in autocrats is noteworthy.

These figures are much too consistent not to mean something very definite. Regard also the percentages for the distribution of all autocrats from the eleventh century to the nineteenth. Omitting fractions, these percentages run: 30, 52, 50, 41, 32, 26, 21, 14, 18. From the twelfth century onward each figure is smaller than the one before, with a slight exception in that for the nineteenth century.

Autocrats were proportionately most numerous in the twelfth and thirteenth centuries. Great autocrats reached the acme of their power in the sixteenth, as did also the gods of war. Perhaps it all may mean that we are at the bottom of a wave that will rise again, but if the records of recent generations are an indication of forces that are destined to be continuous, then in a few generations to come, at least one of the concomitants of war, the great monarchical autocrats, will have ceased to function on this planet.

New Eugenics Society in Hungary

The Hungarian Commission for Race-Hygiene, founded in February, 1914, was reorganized in 1917 as the Hungarian Eugenics Society and is now publishing a bi-monthly journal called *Nemzetvédelem* (Protection of the Race). A communication from its acting vice-president, Dr. Geza von Hoffmann, formerly Austro-Hungarian consul in Berlin and at one time a resident of the United States, tells of the growing eugenic movement in Hungary. He states that the Hungarian government has been carrying on an active campaign for the increase of eugenic knowledge by means of pamphlets, posters, placards, and popular lectures, both in civilian centers and in military establishments.

"Much stress is laid upon the positive side of the question," he observes, "*i. e.*, the propagation of the fit, and no steps have yet been taken to cut off the propagation of the unfit."

THE SPREAD OF ROSEN RYE[1]

Frank A. Spragg
Michigan Experiment Station, East Lansing

IN 1909, the Michigan Agricultural College received a sample of pedigreed rye from Russia. Since the Russian name of this rye was unknown, it was called Rosen rye, after J. A. Rosen, who sent it. Mr. Rosen was a Russian student who graduated from the Agricultural College in 1908.

This sample was selected and tested by the Michigan Experiment Station, and 6 bushels of it were distributed in 1912. As it was generally planted alongside of the common rye, only the offspring of one of these bushels could be continued as pedigreed rye, and this bushel was sent to Jackson County, Michigan. It was planted on an acre and yielded thirty-five bushels in 1913. Soon the whole countryside around Parma (in western Jackson County) and around Albion, in eastern Calhoun County, grew Rosen rye as a winter crop, and little or no wheat. Other counties took it up and, with the aid of an active county agricultural agent, the new rye spread rapidly. St. Joseph County early became a prosperous Rosen rye center, having 3,500 acres in 1917, while Jackson County had 2,000 acres, the whole state having about 15,000.

It seemed to take three or four years for this new rye to attract the notice and the confidence that was needed for rapid advance. Since 1916, however, its spread in Michigan has been almost phenomenal. This has been due chiefly to the intrinsic merit of the grain, combined with the aid of the Michigan Crop Improvement Association in maintaining the quality and purity of the seed produced.

Field inspection began in 1917 under the leadership of the association's secretary, Mr. J. W. Nicolson, East Lansing, Mich., and certified grain began to be sold to the farmers of other states as well as to Michigan farmers. As the result of this activity in wartime, when farmers were being urged to sow the best seed, approximately 250,000 acres of Rosen rye were sown in Michigan in the fall of 1917. The trade also began to take notice of the new rye. It was quoted on the Detroit market that year, and carload lots began to be available for other states as well as in Michigan.

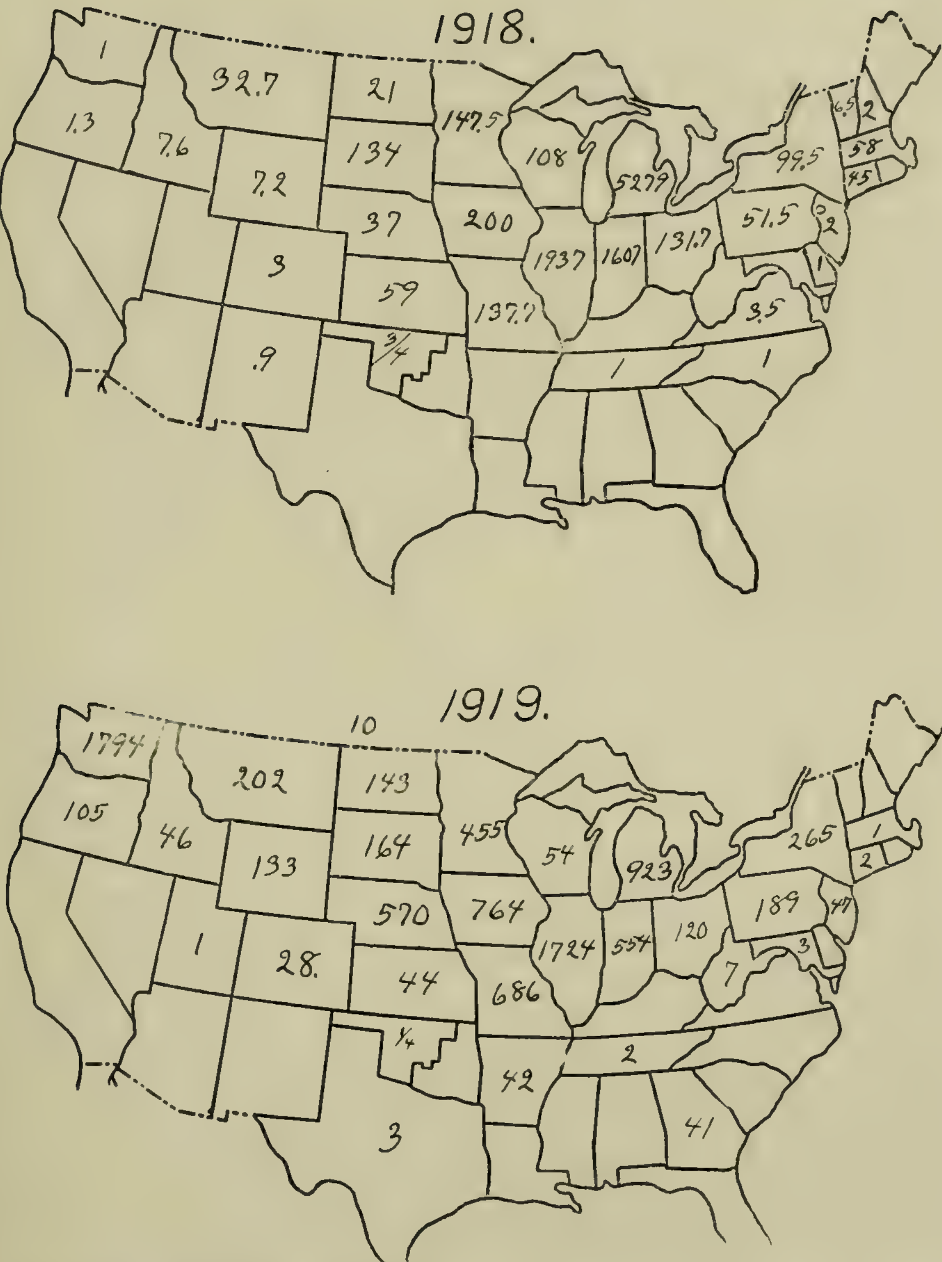
HIGH YIELD AND INCREASED ACREAGE

The inspectors of the Michigan Crop Improvement Association began work again in June, 1918, and during the following month passed about 1,000 acres. This acreage produced 22,349 bushels, a good yield when it is remembered that most of it grew on sandy soil, and that a yield of 15 bushels per acre was considered a high return before the Rosen rye was introduced. Again, under the stress of war conditions, the acreage was almost doubled in one year, as considerably over 400,000 acres in Michigan were sown to Rosen rye in the fall of 1918.

Growing Rosen rye in Michigan is now so general that even the common rye is mixed with it. It is now difficult to find the old-fashioned common rye for class purposes, and the college may soon be compelled to grow common rye as a curiosity. About 85% of the rye acreage of Michigan is more or less pure Rosen. Of this, less than 1.5% is pedigreed. Much of it is nearly as good as the pedigreed, but lost to record under the association.

The growing of Rosen rye in other states began commercially as early as there was a supply. It has gone from

[1] A detailed account of Rosen rye by Mr. Spragg appeared in the Journal of Heredity for December, 1918 (Vol. ix, No. 8).—Ed.



SHOWING NUMBER OF BUSHELS OF PEDIGREED ROSEN RYE SOLD AS SEED FROM MICHIGAN

The upper map indicates the number of bushels sold in 1918, and the lower map shows the figures for 1919. First introduced in Michigan in 1909, this rye had its first extension into other states in 1917. The rapid advance from 1918 indicates that its superiority over the common rye is quickly recognized. (Fig. 19.)

farm to farm across the state line into Indiana and Ohio, until the upper two rows of counties in Indiana have as much Rosen rye as the southern row of counties in Michigan. When carloads began to be available in 1917, the trade grew rapidly, increasing steadily since that year, and now several elevators and seed firms in Michigan count their sales of Rosen rye for seed in dozens of carloads. Much of this seed is purchased in sections where the rye is resonably pure, but, unfortunately, comparatively few people seem to realize the fact that rye cross-fertilizes. A great deal of rye that is now sold as Rosen is very badly mixed. The results obtained with this commercial seed are frequently not equal to those obtained by the use of seed inspected in the field and bin by the Michigan Crop Improvement Association, which coöperates with the College in maintaining very high standards of purity.

ALREADY COMMERCIALLY IMPORTANT

The extension of pedigree Rosen rye into other states began in 1917, when the inspection work began, but the sales made by the members of the association were imperfectly reported that year. For that reason exact figures are unobtainable. However, a fair proportion of these sales have been reported in 1918 and 1919. One outline map, Fig. 19, shows the sales by states in 1918, and another shows the corresponding figures for 1919 as far as they are reported to date. But, as indicated above, this is a very small portion of the seed sold as Rosen, as the commercial trade has assumed vast proportions. The pedigreed seed, however, is the only seed of guaranteed purity, and is therefore the basis upon which this or other states must base opinion regarding the value of Rosen rye.

The figures on the two maps should be carefully studied. so as not to be misinterpreted. In 1918 Illinois and Indiana were the largest purchasers of pedigreed Rosen rye outside of Michigan yet it is probable that Michigan bought more pedigreed Rosen seed than all other states combined. In 1919, Michigan farmers bought less pedigreed Rosen seed than certain other states. The State of Washington, bought almost twice as much pedigreed Rosen seed as Michigan itself did. To explain these facts one must remember that pedigreed or high-grade Rosen is quite generally in the hands of Michigan farmers. They are simply planting their own seed. It is only the few who wish to replace their mixed seed with the pedigreed that are now buying the pedigreed seed in Michigan.

Several states have obtained pedigreed seed for two previous years and should be growing quantities of pure Rosen rye, but we have no record at present. A report comes from Minnesota, where a man purchased the pedigreed Rosen seed from Michigan in 1918 and sold 3,000 bushels for seed in 1919. Others can do likewise. It is the more distant states, where a smaller supply is available, that are purchasing increased amounts.

A Genetic Association in Italy

Leading Italian men of science have united in the "Italian Society of Genetics and Eugenics," whose object is "to promote and support all researches and movements tending to increasing knowledge of the laws of heredity and the improvement of races, with special regard to the human race."

Dr. Ernest Pestalozza is president of the organization and Dr. Caesar Artom secretary. The headquarters are at the Municipal Zoological Garden, Villa Umberto I, Rome.

Control of the society is placed by the by-laws in the hands of fifteen delegates, to be chosen equally from the biological, medical and social sciences.

One of the society's first efforts is to prevent racial hybridization. It has sent out a letter to various organizations such as the American Genetic Association, which reads:

"The directing council of the Italian Society of Genetics and Eugenics has adopted the following proposal of Professor Dr. V. Giuffrida-Ruggieri, professor of anthropology in the Royal University at Naples.

" 'With the victorious termination of the world war, the powers of the entente find themselves more closely than in the past, in contact with the African world. It would therefore be opportune for the various eugenic societies to coöperate by bringing to the attention of the governments of their respective countries the desirability, where it has not already been done, of securing legislation to prevent marriage between Europeans and members of the African races. Marriage should be permitted only with Africans of the Mediterranean race (Berbers, Egyptians) and Arabs who are not negroes. Such a prohibition ought to extend to all the half-breed populations scattered over the African continent.'

"The intention of the proposal would be to prevent the increase of a mixed European-African race, which appears to be undesirable from various points of view."

The Intelligence of the Negro

Applying a group scale of intelligence to the colored school children in two small Indiana cities, S. L. Pressey and G. F. Teter conclude that they show less intelligence than white children in the same cities. Their study is published in the *Journal of Applied Psychology*, Sept., 1919.

Reviewing previous work in this field, the writers say: "Colored school children show a greater school retardation, less acceleration, and average older for a given grade, than do white children. There is some evidence to show that, grade for grade, they do poorer school work. Negro children give ratings, when tested by the Binet and Point scales, averaging below white children. Measurements of special abilities have shown the colored children to do well in tests of the more simple processes (as cancellation, rote memory) and most poorly with tests of the more complex abilities (as opposites, analogies, sentence completion). There is some evidence that colored children have more active imaginations and more ready associations of an uncontrolled type than do white children."

Discussing their own results, the writers point out that among the colored children "a poor average ability seems unmistakably indicated," which not only leads the colored children to be retarded in school, as compared with whites of the same age, but leads them even in the retarded classes to do poorer work than whites in the same classes.

Is this not perhaps due to some special defect, rather than to general inferiority? Apparently not; "the colored children show poorer ability than the whites on every test." There is the definite suggestion "of a more elementary and less highly developed ability among colored children"; but the writers believe "that the important racial difference may be, after all, emotional and temperamental."

VIEW OF FIELD OF DASHEENS IN FLORIDA

"We have acquired the taste for the dasheen, and it is a part of our regular food: to use the expression, we seem to flourish on it." This is the statement of John F. Groene, formerly Justice of the Peace at Tarpon Springs, Fla., who stands among his plants in the photograph. He became so fond of dasheens that on moving to California, he began at once to encourage experimentation with their cultivation there. (Fig. 20.)

Pioneer Growers of the Dasheen

In the introduction of a new vegetable into cultivation, there comes a time when those pioneers, who believe sufficiently in its future, to risk their own labor, land and money in its production, need encouragement. They need to be helped in popularizing the vegetable, and in getting their product before a public that believes in trying new foods.

The dasheen is one of these new foods. It is now being grown as a crop quite generally in the South Atlantic and Gulf States, but mostly in Florida. It is sold by fancy vegetable dealers in many southern and northern cities, and the production heretofore has scarcely kept pace with the growing demand. This season, for the first time, there is opportunity for householders to purchase dasheens direct from growers, or their agents, in the south. Shipments of one bushel or more will be made—preferably by express on account of the danger of delay and freezing if sent by freight. To eastern cities having direct steamer connection with the south, barrel shipments can be safely forwarded by steamer freight.

Following is a list of three growers, and one representative of a number of growers on Lake Okeechobee, with whom any interested persons may communicate. Letters to these men should specify quantity desired, and ask for the price: W. E. Clark (grower), Torry Island, Fla., Fellsmere Co., (grower), Fellsmere, Fla., J. H. Freeman (representative), Ft. Lauderdale, Fla., W. C. Greer, (grower) Torry Island, Fla.

A HILL OF DASHEENS WEIGHING ELEVEN POUNDS

Each hill of dasheens yields one or more large corms, like the two shown above, and a number of cormels, or lateral "tubers;" all are edible. The corms are especially delicious when baked and eaten immediately upon being taken from the oven. (Fig. 21.)

DASHEEN EN CASSEROLE

This is one of the many delicious dishes made from the dasheen. The vegetable is prepared, with slight modification, in all the ways in which potatoes are used, and some besides. It makes an especially excellent filling for fowl. (Fig. 22.)

A NEW DAHLIA OF INTEREST TO PLANT BREEDERS

W. E. SAFFORD, of the Bureau of Plant Industry, has published in a recent issue of the *Journal of the Washington Academy of Sciences* (July 19, 1919), descriptions of two new dahlias from Guatemala, one of which, *D. popenovii,* should be of more than ordinary interest to plant breeders who are working with this genus. According to Mr. Safford, this species is probably an ancestor of the cactus-flowered dahlias, a group derived from *Dahlia juarezii.* The latter species is a hybrid, supposed to have originated naturally in Central America through the crossing of *D. popenovii* and some other species.

Mr. Safford, who is at work on a revision of the cultivated dahlias with a view to determining their botanical relationships, writes:

"In nearly all the monographs on the genus Dahlia hitherto published, the different varieties have been grouped from the horticulturalist's point of view, according to the forms of the flowers, under such headings as 'single, duplex, anemone-flowered, collarette, pompon, fancy, decorative, peony-flowered, and cactus dahlias,' without identifying the single-flowered forms with botanical species (except perhaps in *Dahlia coccinea* and *Dahlia imperialis*) or attempting to connect the 'duplex' and double forms with their primitive single ancestors. It is very probable that the types upon which several species have been based were hybrid plants. *Dahlia pinnata* itself, the type of the genus, was probably a hybrid. In the Index Kewensis its name is discarded as a synonym for the subsequently described *D. variabilis.* In the same way the handsome *Dahlia juarezii* with large double heads composed of strap-shaped florets having their edges turning backward, in sharp distinction to the involute or quilled floets of the artificial-looking 'pompon dahlias' and the broad, flat-rayed heads of the 'century' type of modern catalogues, is also to be regarded as a hybrid. Dahlias with flowers identical in form with the type of *Dahlia juarezii,* the ancestor from which the 'cactus dahlias' of our gardens have sprung, are no longer called 'cactus dahlias' by specialists, but 'cactus hybrids.' One of the ancestors of *Dahlia juarezii* must have been a single-flowered species, with eight revolute ray-florets. Such a plant has recently been discovered in the mountains of Guatemala."

Mr. Safford describes this species, *D. popenovii,* as a plant about one meter high, with slender, purplish stems, the leaves simply pinnate (except perhaps the lower ones), and the flower-heads about 3 inches broad with eight slender, revolute ray florets, bright scarlet or cardinal in color. It differs from the closely allied *Dahlia coccinea* in the shape of the ray florets and the scales, and in the character of its leaves.

This new dahlia is being propagated by the Office of the Foreign Seed and Plant Introduction of the Bureau of Plant Industry, by which it was introduced from Guatemela.

The Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. XI, No. 2 February, 1920

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ERRATA

The title of the legend for Figure 9, page 66, should read:

NORMAL AND "TASSEL SEED" TYPES OF MAIZE

and the title for Figure 11, page 69, should read

NORMAL AND "TASSEL EAR" TYPES OF MAIZE.

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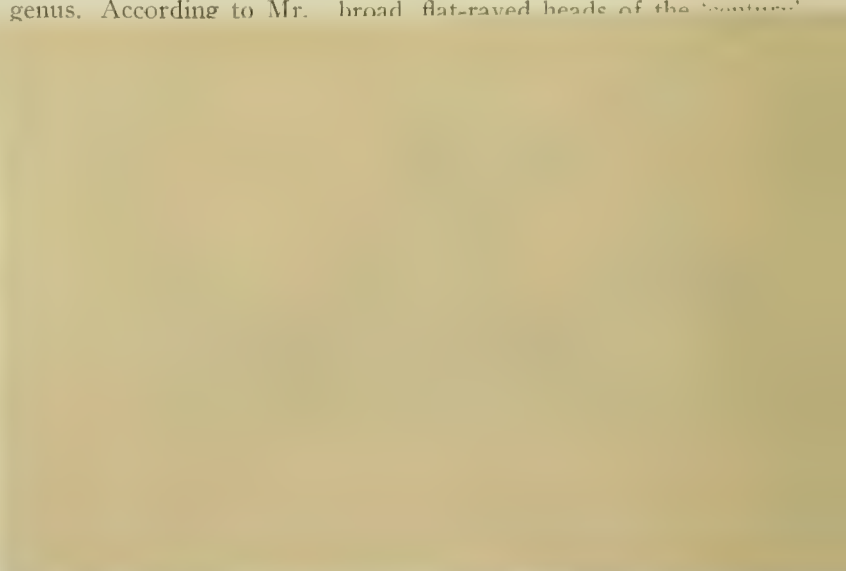

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Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912.

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A WATER BUFFALO COW FROM THE DAIRY HERD AT CANTON CHRISTIAN COLLEGE

The water buffalo is common in all parts of southern China, where its principal use has been as a draught animal in the rice fields. In recent years, however, its importance for dairy purposes has come to be realized. When the animals are no longer useful for work or dairy needs, they are slaughtered for beef. There are favorable possibilities of the water buffalo for dairy purposes in southern United States. (Frontispiece.)

THE WATER BUFFALO—A TROPICAL SOURCE OF BUTTER FAT

C. O. Levine

Associate Professor of Animal Husbandry, Canton Christian College

The water buffalo (*Bubalus bubalis*) is found in all parts of China as far north as Shanghai. It is most common in regions where lowland rice is the main crop grown by the farmers, where it finds its chief use as a draught animal in the wet paddy fields. The estimated common weight of the water buffalo in China is about 800 to 1,200 pounds. Measurements, made by the writer, of twelve cows kept on the college farm have given an average height of 49 inches at the withers.

Like the pig, the water buffalo has few sweat glands in its skin, and for this reason cannot endure hard work in the sun for a long period, unless its body is wet with water. This accounts for the desire of the buffalo to wallow in mud or water. The animals are easily overcome by heat if worked hard in the sun, and sometimes they go crazy and become very dangerous. Not infrequently such an animal has to be killed.

However, animals kept only for milk production, and not required for any work do not necessarily require a water hole for comfort. This is especially true of the dairy breeds of buffalo of India.

As a rule, the water buffalo is a gentle animal—toward Orientals. Europeans usually find this animal difficult to manage, and all attempts by Europeans to raise the buffalo have failed, except in Italy and some other places in southern Europe, where it has been raised for centuries. The dairy water buffalo of northern India, however, although of immense size and fierce looks, is very gentle and can be handled by Europeans as well as by natives of that region.

The horns of the Chinese buffalo are peculiar in shape. They are large and much flattened, or somewhat triangular at the base, deeply grooved on the upper surface, directed out and back from the head and finally curving inward. The length, measured on the outside curve of the horn, is usually a little more than two feet. In walking, the buffalo carries its head so that the face is almost level with the back. Its tail is short, reaching to the hocks. Its skin is a grey-black, very thinly covered with grey-black hair, and has practically no oil or sweat glands. Dean Bailey, in his Cyclopedia of Agriculture, Vol. III, calls attention to the fact that the color of the water buffalo is not unlike that of the elephant, and that their motions are similar The resemblance between these two animals is so similar that a casual view of a moving herd of buffalos suggests a roving band of elephants.

OESTRUS, GESTATION, WEIGHT OF CALVES AT BIRTH, AND AGE OF USEFULNESS

Oestrus in the female buffalo does not occur as a rule until the age of two years. It occurs one month after parturition, and recurs regularly every 28 to 30 days until the animal again becomes pregnant.

Definite records on the exact length of the gestation period have been secured only with two cows at Canton Christian College. In one case it was 310 days, and in the other 314 days.

Three calves, from cows in the college dairy, weighed, soon after birth

BUFFALO COWS ARE EASILY MANAGED BY ORIENTALS

The two cows in this picture are from the Canton Christian College dairy herd. The one on the right (referred to in the records as No. 8) produced milk which averaged 15.5 per cent fat for a lactation period of nine months. Water buffalo milk "contains about three and a half times as much fat and nearly twice as much total solids as does European cow's milk." (Fig. 1.)

THE SAME COWS AS THOSE SHOWN IN FIG. 1

"There are a number of commendable features in the use of the buffalo cow as a dairy animal." There has been no breeding for milk production in China, yet ordinary buffalo cows give more than 260 pounds of butter fat a year. The average milch cow in the United States gives about 160 pounds (not taking into account the higher possibilities shown by many records where over 1000 pounds have been given.) Due to the absence of sweat or oil glands in the skin, and having very little hair on the body, the animals are easy to keep clean. No cases of tuberculosis have been found among them. (Fig. 2.)

and before they had taken any food, an average of 67 pounds. Their weights were 64, 70, and 67 pounds.

In order to secure a long lactation period and the maximum amount of milk, buffalo cows kept for milk are usually not bred until three or four months after freshening. Although the ordinary buffalo of China gives but a small amount of milk, it is extremely rich in fat, and lactation periods of twelve months are common. The cows are considered profitable for dairy purposes until they are about 15 years old.

TO TELL THE AGE OF BUFFALO

The age of a buffalo is indicated quite accurately by the teeth, up to a certain number of years, similar to the way it is indicated in European cattle. Like other members of the bovine group, the buffalo has no teeth in the front of the upper jaw. The calf is usually born with six temporary teeth in the front of the lower jaw. Two more appear a few weeks later. At about three years of age the middle pair of the temporary teeth are replaced by two permanent teeth. When four years old, the ones on either side of the first pair are up and in use. At five the next teeth on either side of the fourth-year teeth are up, and at six the corner teeth are up and in wear. The age of animals more than six years old is roughly estimated by the appearance of the wearing surface of the teeth in the front of the lower jaw. In the younger animals the teeth have a sharp outer edge, the wearing surfaces slope inward, and the teeth are somewhat angular. As the animals grow older the sharp edges of the teeth wear down, the wearing surface becoming more flat and the teeth more round. After eight to ten years the enamel has worn away

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Note by David Fairchild:

It may be interesting in this connection to quote here from a letter which I wrote in Poona, India, in 1901 to the Hon. James Wilson, then Secretary of Agriculture, regarding the Indian breeds of milch water buffalos which are mentioned by Mr. Levine in this article. The possibilities of utilizing these milch breeds in the Philippines so appealed to Mr. Wilson that he ordered the letter published, together with others regarding plants, as Bulletin No. 27, Bureau of Plant Industry, 1902. In this letter the following facts were reported:

"The carabao or water buffalo (*Bubalus bubalis*, Lyd.) is a well-known object in Manila, and its use as a beast of burden thoroughly understood, but, so far as I am aware, little attention has been paid to it as a milk producer.

"Unthinking prejudice, which prevents us from eating many excellent things, may play the same rôle in Manila that it does in Ceylon, and forbid the employment of buffalo milk. If this is so it is a great pity, for there is a race of water buffalos which come from Delhi, India, that gives over 30 pounds of milk per day, while the best Sind cattle give only 18, and this buffalo milk is so rich in fat that 12 to 13 pounds of it make a pound of butter, whereas 20 pounds of milk of a Sind cow are required.

"These Delhi buffalos are easier to keep, less expensive, and cleaner (having almost no hair) than ordinary cattle. They sell for about 180 rupees, or $56 in gold, in Bombay, and can be bought at Dawans, the buffalo market, near Grant Road Station, but could be best secured by applying to Mr. Mollison, Director-General of Agriculture for India, at Poona, who could probably be prevailed upon to arrange to have good specimens picked out.

"In general, the animals are priced according to the amount of milk they give, 10 rupees being added to the price for every two additional pounds of milk given per day.

"Another good variety of milch buffalo is that from Gujarát, called the *Surti*. It yields only about 20 pounds of milk per day, and is sold at from $33 to $36 gold. The cost of keeping this variety per day amounts at Poona to only 16 cents gold, and it is considered the most economical race by Mr. Kelkar, the foreman in charge of the college herd. According to him, a dairy should have both buffalos and Sind cattle. The buffalos are better for butter production, and the cattle are superior for milk purposes, because the milk fetches a better price, being, in fact, much preferred to that of the buffalos, which has a bluish color and a slight, though not disagreeable, odor.

"Both the buffalos from Delhi and Gujarát and the Sind cattle are well worth introducing into the Philippines. The buffalos should be tested for butter making, though they cost more to feed than the Sind cattle, which latter will prove, however, especially useful for milk."

INDIAN AND CHINESE BUFFALO BULLS

A "Ram's Horn" buffalo bull (the name coming from its spiral horns) is shown on the left. These buffalos are from the region of Delhi, India, and are much larger than the Chinese animals. The percentage of fat in the cows' milk is about the same, however. The animal on the right is a Chinese buffalo bull. (Fig. 3.)

HEAD OF A BREED OF WATER BUFFALO FROM THE GYR HILLS IN GUJARAT, BRITISH INDIA

It is called the Jaffarabad breed, and is not one of the good milch breeds, being too large in size and a poor milker. Photograph by David Fairchild, Feb., 1902. (Fig. 4.)

and yellow centers show on the wearing surface of each tooth.

USES OF THE WATER BUFFALO

Although in the past the principal use of the water buffalo in China has been for draught purposes in the rice fields, during recent years an increasing number are being used for dairy purposes. When the usefulness of the animals for work or dairy purposes is past, they are slaughtered for beef.

CHARACTER OF BUFFALO MILK

The milk of the water buffalo is pure white in color. Butter made from the milk is also pure white. It is wholesome and palatable when produced under sanitary conditions. Students and teachers (both Europeans and Chinese) at the Canton Christian College, prefer drinking buffalo milk to European cow's milk. The objectionable flavor often found associated with buffalo milk is usually due to the production of the milk under unsanitary conditions which generally prevail in most village dairies.

MILK ANALYSIS AND RECORDS

The following tables give the analysis of milk and production records of cows for which we have records extending over a period of several months, or for entire lactation periods.

Butter fat analyses of the milk from each cow were made twice a month with a Babcock centrifugal tester. The milk for 24 hours was weighed twice a month. The average of the two tests was taken as the average test for the month.

The total solids (consisting of the fat, sugar, proteids and ash) were found by evaporating a weighed sample of milk in a steam bath until the weight became constant. The ash was determined by heating in a crucible over a gas flame until the weight became constant. The proteids were determined by the Kjeldahl method as described by Hawk in his "Practical and Physiological Chemistry," 4th edition, pages 438 and 401. The sugar was found by subtracting the sum of the ash, proteids, and fat from the total solids. The percentages in each case were found by dividing the weight of the final product by the weight of the sample of milk analyzed. Analyses and records of buffalo milk are all from cows in the college dairy.

The buffalo cows were fed a grain ration consisting of two pounds wheat bran and one pound rice chop. Each cow was fed about a pound of this mixed feed a day for each pound of milk given daily. The rice chop was fed cooked (the Chinese always feed cooked rice chop to live stock, never uncooked). The grain was fed separately to each cow twice a day. About one and one-half ounces of salt were fed daily to the cows. The salt was mixed with the grain. About 40 pounds of water were mixed with the rice chop and bran at each feeding, making a very wet feed, the cows drinking it down rather than eating it. (This is the usual method of feeding grain to cattle by the Chinese.) The cows were fed all they could consume, four times a day, of a mixture of green cut grass, which amounted to from 40 to 60 pounds a day per cow.

COMMON DISEASES OF CATTLE AND BUFFALO

Rinderpest.—Among cattle and buffalo the most common disease is rinderpest, called by the farmers "ngau wan." It is contagious. This disease causes a loss of millions of dollars every year in China, as it did in the Philippines before compulsory vaccination of cattle with anti-rinderpest serum was adopted by the government of the Islands. The disease is somewhat like the chronic form of hog cholera, in that it is usually accompanied with fever and causes lesions on the inner lining of the intestines. It is not as fatal, however, as cholera is among hogs.

Tick Fever.—Tick fever, commonly known in the United States as Texas fever, after the region in which it is

A DELHI MILCH WATER BUFFALO

This Indian buffalo cow has given over 30 pounds of milk per day. Thirteen pounds of buffalo milk yield one pound of butter, whereas it requires 25 pounds of ordinary cow's milk to yield the same amount. In Poona, India, these milch carabaos are sold according to their milk yield, 10 rupees being added for each two pounds of increase in yield of milk. Only eight pounds of milk of the Chinese water buffalo are necessary to produce one pound of butter fat. The Indian buffalo produces twice as much fat per pound as do ordinary cows, and the Chinese buffalo produces over three times as much. Photograph by David Fairchild, Poona, India, Feb., 1902. (Fig. 5.)

most common in the United States, is prevalent in south China. Native cattle are largely immune to the disease as they are in Texas, and in India where the disease is common. The disease is caused by a protozoan (*Piroplasma bigeminum*) carried by a cattle tick (*Boophilis annulatus*) in a way similar to that by which malarial fever in man is caused by a protozoan injected into the body of man by the mosquito. The young ticks hatch from eggs laid in the grass where cattle graze. The small ticks emerge from the egg, crawl up the legs of cows and buffalos, and attach themselves to the body of the animal and begin sucking blood, remaining attached to the animal until they have grown to full size. The females, after having been fertilized by the males, drop to the ground and lay their eggs, from 1,500 to 3,000 each, which soon hatch and thus complete the life cycle. Tick fever is fatal to cattle imported from tick-free regions. Fortunately, ticks do not travel far and live only in grass; cattle kept in barns and in dry lots are in little danger from them.

Tuberculosis. — According to Dr. Heanley of the Hongkong Bacteriological and Vaccine Laboratory, tuberculosis has never been found among the buffalo of south China; and during 13 years of inspection of animals and carcasses in the Hongkong government slaughter house where all animals are slaughtered for food are inspected by government inspectors, only two cases in the humped cattle have come to notice. Both cases were bullocks. The disease is as common among European cattle in southern China as it is in America.

DAIRYING IN CHINA

In the past the Chinese have not been consumers of milk. Contact with the Europeans in recent years, however, has taught them the value of this product as a food, and now in the larger cities there is an increasing demand for it. According to old residents in Canton, there were no cows used for dairy purposes in that city 25 years ago. Today there are about 600 cows of European breeds and 100 buffalo cows, kept exclusively

TABLE I.—*Analysis of Milk from Individual Cows.*
(Summarized from detailed records for each cow.)

Number of buffalo cow	Length of lactation period by months	Total amount of milk, pounds	Total amount of fat, pounds	Average per cent of fat
1	Last 6 months only	,520	67.51	12.23
2	8 months	1,081	127.56	11.80
3	Last 6 months only	635	82.23	12.95
4	11 months	1,332	168.03	12.63
5	Last 5 months only	575	75.44	13.12
6	Last 6 months only	555	68.49	12.34
7	Last 5 months only	425	58.74	13.82
8	Last 6 months only	363	56.20	15.48
51	11 months	2,671	257.95	9.65
53	First 7 months only	1,766	185.60	10.51
54	First 9 months only	2,242	271.95	12.13
55	9 months	1,852	219.65	11.86
60	First 6 months only	1,531	171.47	11.20
63	First 6 months only	1,639	167.01	10.19

NOTE.—When these records began, No. 1 had been milking for 4½ months, No. 3 for 2⅓ months, No. 5 for 5 months, No. 6 for 5 months, No. 7 for 8 months, and No. 8 for 8 months. When these records closed, No. 53 was giving 5 pounds of milk a day, No. 54, 6 pounds, and No. 60, 8.2 pounds.

for milk. All the dairies in Canton are managed by Chinese, and their customers are practically all Chinese. In Hongkong, there are several hundred cows kept for dairy purposes. Much condensed milk is also imported and used in China.

EUROPEAN BREEDS IN CHINESE DAIRIES

Most of the European cows in the dairies of Canton and the Chinese dairies of Hongkong are of mixed breeding. All the dairy breeds, and the Shorthorns are represented, although the Shorthorn blood predominates. Blood of the other breeds rank in the following order: Holstein, Guernsey, Ayrshire, and Jersey. The Hongkong Dairy Farm Co., owned and managed by British, has chiefly Hol-

Table II.—*Complete Analysis of Buffalo Milk.*

The samples analyzed were herd samples taken from twelve cows in the College dairy in November, 1917. The milking in the morning was begun at four, and in the afternoon at two o'clock.

Sample No.	Per cent fat.	Per cent ash.	Per cent protein.	Per cent sugar.	Total per cent solids.	Per cent water.
1. Morning milk	11.00	0.94	6.04	4.00	21.98	78.02
2. Afternoon milk	12.80	.90	6.10	3.57	23.37	76.63
3. Afternoon milk	13.00	.71	5.71	3.32	22.74	77.26
4. Afternoon milk	13.63	.74	5.94	3.57	23.88	76.12
5. Afternoon milk	12.10	.90	6.14	3.83	22.97	77.03
6. Afternoon milk	14.00	.92	6.42	3.87	25.21	74.79
7. Morning milk	11.50	.95	5.80	3.70	21.95	78.05
8. Morning milk	12.00	.94	6.00	3.60	22.54	77.45
9. Morning milk	12.34	1.04	6.28	3.71	23.37	76.63
10. Morning milk	12.20	.77	5.90	4.23	23.10	76.80
Averages	12.46	.89	6.03	3.74	23.11	76.89

Table III.—*Complete Analysis of European Cow's Milk. Analysis Made During January and February of* 1917

Sample	Per cent fat	Per cent ash	Per cent protein	Per cent sugar	Per cent total solids	Per cent water
1	3.20	0.845	3.18	6.47	13.70	86.30
2	3.50	.840	3.20	5.28	12.82	87.18
3	4.50	.736	3.24	5.18	13.68	83.32
4	4.60	.900	4.10	5.20	14.80	85.20
5	3.80	.780	3.25	5.54	13.37	86.63
6	4.44	.800	3.10	5.60	13.94	86.06
7	3.50	.880	3.80	6.00	14.18	85.82
8	4.10	.888	3.40	5.63	14.02	85.98
9	5.20	.740	3.20	5.30	14.44	85.56
10	4.00	.800	3.05	6.10	13.95	86.05
Averages	4.08	.821	3.35	5.63	13.89	86.11

Note.—Samples 1 and 2 are of milk from the Hongkong Dairy Farm Co., in Victoria, Hongkong. The samples are taken from bottled milk from a herd of from 500 to 700 European cows, most of which are Holsteins. Samples 3, 4, 5, 6, and 7 are from the mixed milk of the Sinkee Dairy in Canton. In this dairy 90 to 100 foreign cows are kept, Guernsey and Shorthorn blood predominating.

Samples 8, 9, and 10, are from the mixed milk of four cows in the Canton Christian College Dairy. These four cows are of mixed breeding, Shorthorn blood predominating.

AN INDIAN "RAM'S HORN" BUFFALO BULL

The "Ram's Horn" buffalos come from the region of Delhi, India, and differ from the Chinese buffalos. They are being imported in large numbers for dairy purposes in the Philippine Islands. In milk and butter fat production they rank with the best breeds. (Fig. 6.)

stein cows. This dairy has from 600 to 900 cows of dairy breeds, but no water buffalo.

INDIAN DAIRY BUFFALOS

At Kowloon, Hongkong, there is a herd of about 20 Indian buffalo cows managed by Indians. The buffalos in this herd have been imported from the region of Delhi, in the northern part of India. These buffalos are different from the Chinese buffalos, being much larger, some of them 5 feet tall at the withers. They have large spiral horns, and for this reason they are known as the "Ram's Horn" buffalo in the Philippine Islands, where they are being imported in large numbers for dairy purposes. The milk, according to Dr. Gibson, the colonial veterinarian of Hongkong, contains about the same per cent of fat as the Chinese buffalo milk. They are said to give up to 60 pounds of milk a day in India when on good feed. At the Indian dairy in Kowloon, when visited by the writer in January, 1919, the average production for twenty cows, then producing milk, was about 15 pounds. The feed at that time consisted of dry rice straw for roughage, and a little cooked rice chop and wheat bran. The cows were crowded into a dark, poorly ventilated, and dirty barn, and were very filthy. It is the writer's opinion that with proper care and feed, the production of the cows in this herd could easily be doubled. The cows have a well developed mammary system with large teats.

THE BUFFALO COW AS A DAIRY ANIMAL

There are a number of commendable features in the use of the buffalo cow as a dairy animal. The amount of milk in the better buffalo cows of China (see production tables) is not insignificant when we consider that there has been no breeding for production. Ordinary cows give more than 2,000 pounds of milk and 260 pounds of fat a year. *The "Ram's Horn" buffalo from India rank with the best breeds of modern dairy cattle in production of both milk and butter fat.* The fact that the buffalo has practically no

WATER BUFFALOS TAKING THEIR "TWICE-A-DAY"

"Buffalo cows need a bath twice a day in order to keep at their best," although animals which are kept for dairy purposes only have appeared to do equally well with less frequent bathing. Animals used for draught purposes cannot work long in the sun without having their bodies frequently wet with water. This is due to the absence of sweat glands in the skin. (Fig. 7.)

TWO CHINESE WATER BUFFALO COWS AND THEIR CALVES

Note that, while the mature animals have very little hair on their bodies, the calves possess a thin covering of long hair. (Fig. 8.)

sweat or oil glands in the skin makes it an easy animal to keep clean. The scant hair on the body affords a poor hiding place for lice, so that they can easily be detected and eradicated. The absence of tuberculosis among buffalos, and their resistance to the tick fever, adds much to their value as dairy cows. The breeding of the native buffalo of China for milk production, and the importation of Indian dairy buffalos should be encouraged in every way possible, rather than the importation of European cows to China, because of the danger from tuberculosis in the latter.

OBJECTIONS TO THE BUFFALO FOR DAIRY PURPOSES

The chief reason why so few buffalo cows are used for dairy purposes in China is no doubt due to the fact that they give but little milk, and that, *while the milk contains about three and one-half times as much fat and nearly twice as much total solids as does European cow's milk, it usually sells for the same price.* However, as soon as the public knows the value of buffalo milk it should command a much higher price than it does at present. Cows which have not been especially bred for milk production, but were simply selected from ordinary buffalo cows, produce as much as 10 pounds of milk a day for several months. This fact indicates that individual cows, giving a much larger amount of milk, may be secured in a few generations of selection and breeding for dairy purposes.

Some authorities claim that buffalo cows need a bath twice a day in order to be kept at their best. It is the custom for animals to be driven to canals

TABLE IV.—*Analyses of Canton Buffalo Milk and European Cow's Milk Compared.*

(The per cent of fat represents the average of about 800 analyses, and the per cent of the other constituents represents the average of 10 analyses made by the writer.)

	Canton Buffalo milk, per cent	European cow's milk in Canton, per cent	European cow's milk in America, per cent[1]
Fat	12.60	3.80	3.69
Proteids	6.03	3.35	3.53
Sugar	3.74	5.63	4.88
Ash	.89	.82	.73
Total solids (including the fat, ash, proteids and sugar)	23.11	13.89	12.83
Water	76.89	86.11	87.17

TABLE V.—*Analysis of Buffalo Milk in Southern China Compared with That in Other Countries*

	Southern China per cent	India[2] per cent	Philippine[3] Islands per cent	Italy[4] per cent
Fat	12.60	7.95	6.84	7.99
Protein	6.03	4.00	4.97	4.13
Sugar	3.74	5.18	5.16	4.75
Ash	.89	.78	.83	.97
Water	76.89	82.09	82.20	82.16

[1] From Wing: "Milk and Its Products," p. 17.
[2], [4] from Bailey's Cyclopedia of Agriculture, Vol. iii, page 295.
[3] *Philippine Agriculturalist and Forester*, Vol. vi, December, 1917, page 110.

or ponds, places which are not always clean, for this purpose. To overcome this objection, tanks might be constructed in which clean water could be kept for their bath, or they may be washed by pouring clean water over them with buckets, or with a hose where water pressure can be secured. However, animals kept for dairy purposes only, seem to do just as well on very infrequent bathing, or no bathing at all.

FUTURE OF THE WATER BUFFALO IN DAIRYING

In India the water buffalo is the chief source of milk, although it is competing not only with good native breeds of the "humped" variety, but also with all the modern breeds of European dairy cattle.

It is the opinion of the writer that the water buffalo must become the leading dairy animal in the southern half of China, and an important source of milk for the four hundred million people of that land. Unlike the Indians, the Chinese in the past have not been users of milk, but are rapidly taking up the use of this beverage through the example set by Europeans in China.

With a few generations of intelligent selection and breeding among the water buffalos of China, there will be developed a dairy breed of high producing ability, especially in butter fat. The possibility of this is shown in the work at the Canton Christian College by the fact that with no breeding or selection whatever, cows from an ordinary village herd, whose ancestors had never been milked, gave more than 2,000 pounds of milk containing as much as 270 pounds of fat in less than a year. The Indian dairy breeds will also be imported into China

The history of both the dairy and beef breeds of European cattle in most parts of the Philippine Islands has been but little more than keen disappointment and failure. The climate and diseases of the islands are such that European cattle quickly succumb to diseases or degenerate from generation to generation. The last legislature of the Philippine Islands appropriated a large sum of money for the improvement of live-stock in the islands. Not any of this money is being used for the importation of breeding stock of European breeds of cattle. On the other hand the sum of 200,000 pesos ($100,000 U. S. currency) is being used for the importation of the Delhi dairy buffalo from India.

It is difficult to prophesy as to the future of the water buffalo in the United States—if it is to have a future in this country. There is no doubt that the buffalo will thrive in most parts of the South, as far north as the southern part of Oklahoma. Most regions farther north will probably prove to be too cold. The swamps and marshes of Florida, Mississippi, and Louisiana should be especially adapted to water buffalo production.

The fact that buffalo is free from tuberculosis, as well as an excellent producer of milk and butter fat, may result in an attempt at its introduction in the southern part of the United States. The development of dairy buffalo production in this country will help meet the increasing shortage of milk and butter fat supply from animals absolutely free from tuberculosis. Also, large areas of swampy land which cannot be drained but which supply abundant grasses on which the water buffalo will no doubt thrive, will be rendered productive. However, extreme care will be necessary to prevent introducing with the animals the diseases which have not yet found a footing in this country. Further careful study of the water buffalo should be made in its native land in order that we may become more acquainted with this class of bovine before the attempt is made to raise buffalo in America.

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To Increase the Birth Rate

Changes in taxation, and an insurance plan for parents, as methods of increasing Germany's present low birth-rate, are discussed by Wilhelm Schallmayer in *Die Umschau* (Nos. 32 and 33, 1919).

He properly condemns present income taxes that fail to make any allowance (as is apparently the case in Germany) or that make an inadequate allowance (as in the United States) for the presence of children in a family. He cites with approval the proposal of Max von Grubin, the Munich hygienist, who proposes that parents shall not be allowed to bequeath their entire estate to their children unless the latter number at least four. Schallmayer and von Grubin believe that many well-to-do parents restrain the size of their family in order that they may bequeath a competence to each child, and they would give the parents an incentive to have at least four children. If they have only two or three, for instance, the proposed law would allow these to inherit only one-half or three-fourths of the estate, to all of which they are entitled under the present law. The undistributed surplus would be distributed, in von Grubin's plan, to collateral relatives in proportion to the size of their families; and in Schallmayer's plan one-half to the collaterals and one-half to the state for eugenic purposes.

Moreover, says Dr. Schallmayer, the cost of the offspring should be borne by the state, through the establishment of a state parenthood insurance bureau, to which all persons of either sex would be admitted, premiums to be based on income. A stipulated benefit would be paid on the birth of each child, up to a limited number, this proviso apparently being to keep poor stock from proliferating unduly in order to get bonuses.

The author points out that a large part of the excessive infant mortality is due to carelessness, and in order to discourage such carelessness he would refuse to pay for a child until it has passed its first birthday.

He declares that steps must be taken to keep the racial contribution of each section of the population proportionate, in order to keep the inferiors from outbreeding the superiors. It is unfortunate that he fails to outline effective steps to this end, since this is in many ways the most important part of the plan and the point where most authors of similar plans have stopped short.

In conclusion Dr. Schallmayer soundly says that the only real insurance of a properly distributed birth-rate is the spread of a "eugenic conscience" in the population.

HERITABLE CHARACTERS OF MAIZE

II.—PISTILLATE FLOWERED MAIZE PLANTS[1]

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IN THE "freak" class at the Annual Corn Show held at Lincoln, Nebraska, in the winter of 1913-14, there was exhibited a corn tassel with a heavy setting of seeds. A few seeds are not infrequently found in the staminate inflorescence of maize, particularly in pod corn, and tillers of various corn varieties often end in ears instead of in tassels or have tassels, the central spikes of which are ear like. The freak exhibited at the corn show, however, was a large, much branched affair, wholly tassel-like in form except for the fact that it bore a heavy crop of seed like a well-filled head of broom corn or sorghum. It retained no indication of having had any staminate flowers. It was apparently a wholly pistillate inflorescence, though tassel-like in form.

This freak specimen came into possession of the writer, and seeds were planted at the Nebraska Experiment Station in the spring of 1914. All the resulting plants had normal tassels with no pistillate flowers and normal ears wholly pistillate, and were typical representatives of a large, rather late white dent variety commonly seen in the Middle West. The fact that no abnormal plants appeared was not unexpected, for the parent plant, being pistillate flowered, must have been pollinated throughout by other plants, presumably normal ones. If the abnormality in question were recessive, it would not appear in the first generation from crosses with normal plants.

One of the normal plants was self-pollinated. The progeny of this plant, grown at Ithaca, N. Y., in 1915 and later seasons, consisted of both normal plants and plants with pistillate flowered tassels like the original tassel found at the corn show. Evidently the abnormal tassel is inherited as a recessive to normal. On account of the tassel-like form of this pistillate inflorescence and of its position at the top of the stalk, the abnormality is known as "tassel seed" and is designated by the genetic symbol *ts*, its dominant normal allelomorph being *Ts*.

Wholly pistillate flowered plants appeared also in an unrelated lot of maize grown in 1915. The parent plant was grown in 1914 along with others of the variety known as Pride of the North. All these plants were normal, were rather small and very early, and had red-cobbed yellow dent ears typical of the variety. The seed was from a bulk sample obtained from the Agronomy Department of the Nebraska Experiment Station, the original stock having come from Mitchell, S. D. Several of the 1914 plants were self-pollinated, but only one showed abnormalities in the 1915 progenies. The progeny of this one plant consisted of normal plants and plants that had wholly pistillate flowered tassels. Evidently this abnormality also is inherited as a recessive. At first it was assumed to be identical with the one first described, but this is now known not to be the case. To distinguish it from the tassel-seed type, and because of the more nearly ear-like form of the tassel, it is called "tassel ear" and designated by

[1]This is the second in a series of papers on the heritable characters of maize, the first by G. N. Collins and J. H. Kempton, on "Lineate Leaves," having appeared in the January number of the Journal. The next will be a brief discussion of "Brachytic Culms."—Editor.

NORMAL AND "TASSEL EAR" TYPES OF MAIZE

A pistillate flowered maize plant, called "tassel seed" is shown on the right. That on the left is a normal plant from the same pedigree culture. The silks of tassel seed push out of the upper sheaths at about the same time that tassels appear on normal plants. (Fig. 9.)

A LATER STAGE OF THE TWO TYPES SHOWN IN FIG. 9

A normal plant on the left and a tassel-seed plant on the right. The silks of the terminal inflorescence of the tassel seed had been pollinated some days before and are withered, while the silks of the true ears are still fresh. (Fig. 10.)

the genetic symbol *tc,* the dominant normal allelomorph of which is *Tc.*

DESCRIPTION OF TASSEL-SEED AND TASSEL-EAR TYPES

The peculiarities of tassel seed and tassel ear are best appreciated by an examination of the illustrations accompaying this account. In Fig. 9 are shown two nearly entire plants of the same pedigree culture at the time the terminal inflorescence is pushing out of the upper sheaths. At this stage, ear shoots have not appeared above the sheaths in either the normal or the tassel-seed plant. A latter stage in the growth of such plants is seen in Fig. 10. The tassels, both staminate (normal) and pistillate (tassel seed), appear at about the same time, before the plants have completed their height growth and before ear shoots have appeared from the sheaths. By the time the plants have reached their full height and when the pollen has been largely shed from normal plants (Fig. 10), the silks of the terminal inflorescence of the tassel-seed plants are usually withering on account of having been pollinated. True ear shoots have by this time appeared in the usual position, not only on the normal but also on the tassel-seed plants. Since the terminal silks of tassel-seed plants appear and are receptive before pollen is shed from normal plants of the same stage of development, they are pollinated at once from earlier maturing plants, in which case they soon wither, or if no early normal plants are near, the silks remain fresh and continue to grow until pollen is shed by the normal plants of their own stage of growth. The terminal silks of such plants are usually pollinated before the silks of the true ears of the same plants have appeared. The latter are ultimately pollinated, however, and soon wither, and seeds begin to develop. Whether or not the true ears continue to develop seems to depend upon how fully the tassel silks have been pollinated. When the tassels set a full crop of seed the true ears usually fail to develop far and ripen no seed, but when, from one cause or another, little or no seed forms in the tassels, the true ears develop normally.

Full-grown tassel-seed plants are nearly as tall as normal plants of the same cultures (Fig. 10) and have about the same number of leaves. Tassel-ear plants, on the contrary, are much shorter than their normal sibs. As seen in Fig. 11, tassel-ear plants have nearly as many leaves as normal plants, but have considerably shorter internodes. The terminal silks of tassel-ear plants appear at about the same stage of plant growth as do those of tassel-seed plants. True ears also appear in many cases, but much less frequently than with tassel-seed plants. If the tassel silks are removed at an early stage, true ears usually develop normally, except that they are often tardy in appearing. On the whole, tassel-ear plants are considerably weaker than tassel-seed plants.

The differences between tassel seed and tassel ear with respect to the form of the terminal pistillate inflorescence are well shown in Figs. 12 to 16. In tassel seed the inflorescence is loose like that of most tassels, the individual spikelets being more or less separated. The tassels of normal plants of different strains differ much in the density of their spikes. It is not surprising, therefore, to find variations in the density of tassel-seed inflorescence in somewhat unrelated cultures, such as the second and later generations from crosses with diverse sorts of normal plants. Just such diversities are seen in Figs. 12 and 15. In some cases the tassel-seed inflorescence is fairly dense (Fig. 15), though even here there is little resemblance to an ordinary ear. Some are very loose (Fig. 12), and others intermediate. In rare cases (Fig 12) staminate flowers develop with the pistillate ones throughout the greater part of the tassel. Whether or not these staminate flowers are functional has not been determined. The glumes and palae of such flowers are long, narrow,

NORMAL AND "TASSEL SEED" TYPES OF MAIZE

A second type of pistillate flowered maize, called "tassel ear," is shown on the right, with a normal plant on the left. Tassel-ear plants are much smaller and weaker than tassel-seed plants. They have about as many leaves as normal plants of the same families but their internodes are shorter. (Fig. 11.)

and pointed as in normal tassels, while, in case of the pistillate flowers, these parts are shorter, broader, and more rounded.

The terminal inflorescence in tassel ear, on the other hand, is always compact and distinctly ear-like (Fig. 16). The glumes and palae are short, broad, rounded, and in all respects much like those of true ears. This can be seen not only in immature tassel ears (Fig. 14), but in mature ones as well, particularly when poorly pollinated (Fig. 16).

The terminal inflorescences of both tassel seed and tassel ear are very subject to attacks of smut, much more so than normal tassels. When attempts are made to guard these pistillate flowered tassels against foreign pollen in artificial pollination experiments, the smut fungus develops under the paper bags used in such work even more than when the inflorescences are exposed. Moreover, since the silks protrude from the sheaths while the upper leaves are still closely crowded together owing to the short upper internodes at this stage (Figs. 9 and 11), it is very difficult to protect the silks against accidental pollination. Either the upper leaves must be removed or enclosed with the silks in large paper bags. Again, the weight of the tassels when the seed has begun to develop often causes the tassels to break off in storms. But, fortunately, it is not necessary to make use of the terminal inflorescence in artificial pollinations. If the tassels are removed as soon as the silks appear, the true ears develop with little delay and can be pollinated just as in case of normal maize.

INHERITANCE OF TASSEL SEED AND TASSEL EAR

Mention has been made above of the fact that these abnormalities are recessive in inheritance. The original open-pollinated tassel-seed specimen produced 28 normal plants. Several tassel-seed plants occurring as segregates in later generations were crossed with normals, resulting in 64 normal plants. Various F_2 progenies were grown and gave a total of 238 normal to 67 tassel seed. This is a deviation of only 9.3 $\pm$ 5.1 seeds from the 3 : 1 relation expected when parents differ in a single pair of factors. When F_1 plants of some of these same crosses were backcrossed with the recessive tassel seed, there resulted 368 normals and 381 tassel seed, a deviation of only 6.5 $\pm$ 9.2 seeds from the expected equality. Four self-pollinated F_2 normals bred true in F_3, giving a total of 128 normal plants, while 10 other F_2 normals broke up again, throwing both normal and tassel seed in F_3. Evidently, tassel seed is differentiated from normal by the single factor pair *Ts ts*. It is assumed that the recessive tassel-seed plants would breed true if it were possible to test them. But, owing to the lack of staminate flowers, they can neither be self-pollinated nor crossed with other plants of the same type.

Tassel-ear plants crossed with normals gave 24 normal plants in F_1 and total F_2 progenies of 260 normal to 36 tassel ear. This is too great a deviation from a 3 : 1 relation to be due to chance. The expected numbers on a 3 : 1 basis with a total of 296 are 222 and 74, and the deviation is a 38 $\pm$ 5 plants. Such a deviation could not be expected to occur by chance even once in some millions of trials. The possibility is at once suggested that normal and tassel ear differ by two factor pairs, and that the F_2 progenies approach a 15 : 1 instead of 3 : 1 ratio. But the numbers calculated on this expectation are 277.5 and 18.5, a deviation of 17.5 $\pm$ 2.8. Even such a deviation as this would not occur by chance more than once in perhaps one hundred thousand trials. It is, of course, possible that in some crosses the parents differ by one factor pair and in others by two pairs. But no F_2 family with large numbers approached closely either a 3 : 1 or a 15 : 1 ratio.

If two factor pairs are concerned, about half of the normal F_2 plants, taken at random, should breed true normal, while, in case a single factor pair

MATURE INFLORESCENCE OF TASSEL SEED

A loose type like this sometimes has staminate flowers and even a few wholly staminate spikelets, particularly at the end of the branches. (Fig. 12.)

TERMINAL INFLORESCENCE OF TASSEL-SEED TYPE

In the terminal inflorescence of tassel seed, the "tassel" is a loose panicle like that of normal plants, but is almost wholly pistillate flowered. The branches are usually slender and the spikelets fairly well separated. (Fig. 13.)

TERMINAL INFLORESCENCE OF TASSEL-EAR TYPE

In the terminal inflorescence of tassel ear, the "tassel" is compact, with the spikelets crowded close together. Both the central spike and the branches are decidedly earlike (Fig. 14.)

is involved, only one-third should do so. Of 17 F_2 normals tested, 5 bred true and 12 broke up. This is certainly nearer the expectation for a single factor pair than for two pairs, but the numbers are too small to allow a definite decision. The F_3 lots not breeding true consisted of 745 normal and 78 tassel-seed plants. This is a deviation from a 3 : 1 ratio of 127.8 $\pm$ 8.4 and from a 15 : 1 ratio of 27.5 $\pm$ 4.7. While the observed numbers fit a 15 : 1 ratio much more closely than a 3 : 1 ratio, the fit is too poor to be due to chance alone. Moreover, if the F_2 relation were really 15 : 1, in F_3 some 3 : 1 as well as 15 : 1 ratios should have appeared, but none of these F_3 ratios were smaller than 6 : 1, and only 3 of the 17 were smaller than 10 : 1.

A bit of evidence favoring the assumption of two factor pairs differentiating tassel ear from normal is afforded by back crosses of F_1's with the recessive tassel seed. Four such back crosses gave 121 normal and 49 tassel ear. A 3 : 1 relation is expected from such crosses if two factor pairs are involved. The deviation from the 3 : 1 ratio is 6.5 $\pm$ 3.8, not a very bad fit. Another back cross, in which the F_1 plant was not closely related to those concerned in the back crosses noted above, gave 53 normal and 43 tassel ear, a deviation from equality of 5 $\pm$ 3.3. On the basis of the two-factor hypothesis, some normal plants are expected to have one of the two recessive pairs. Such normals when crossed to tassel ear should, of course, give a 3 : 1 ratio in F_2 and a 1 : 1 ratio from a back cross.

While the facts given above are favorable in part to the idea that tassel ear is differentiated from some normal types by two factor pairs, itself being a double recessive, the evidence is far from convincing. The writer is much inclined to think that there is another way of accounting for the deficiency of tassel-ear plants below the 25% expected on the basis of a single factor pair. Tassel ear is at best a small, weak type. In this respect it is not greatly different from "dwarf," a form described by the writer some years ago. Under ordinary field conditions, dwarf plants almost never appear in numbers approaching those theoretically expected. It has been possible, however, by germinating F_2 and back cross seeds in seed pans in the greenhouse, to show that dwarf is a simple Mendelian recessive. Carefully germinated seeds grown in large numbers have given almost exactly the expected percentage of dwarfs. Dwarfs are apparently often unable to germinate under field conditions or die soon after germination. This is so well known that progenies expected to contain dwarfs are almost always started in the greenhouse and later transplanted to the field.

It is not known as yet whether tassel ear behaves in this respect like dwarf, but, since the plants are small and weak, it seems probable that the deficiency seen in the field may be due to a failure of tassel-ear plants to survive. In this connection it is important to note that most of the records presented above were made from progenies grown under unusually adverse conditions. The soil in which they were grown is a heavy clay. Even the normal plants of the same families showed by no means a perfect stand. Previous inbreeding, in case of the F_3's particularly, had greatly weakened the whole stock. A number of F_4 progenies, grown from these weak F_3 normal plants, were even less vigorous than the F_3's. Out of 15 such F_4 lots, involving 486 plants, in only three lots did any tassel-ear plants appear, and here they numbered only 6 as against 80 normals. In two F_3 families, coming from a cross of tassel ear with a strong and quite unrelated normal stock, there appeared 44 normal and 13 tassel-ear plants, very nearly a 3 : 1 relation. Now the field notes show that these lots were the most vigorous of all those grown that season. It seems likely, therefore, that observed deficiencies of tassel ear are to be explained just as similar deficiencies of dwarf are, but this cannot

be determined until seed-pan germination is tried out.

TASSEL SEED AND TASSEL EAR AS GENETICALLY DISTINCT TYPES

It was stated early in this account that tassel seed and tassel ear were at first supposed to be identical, but that they are now known to be distinct types. The only evidence so far given in support of this statement, however, is the fact that the terminal inflorescence of tassel seed is a loose panicle, while that of tassel ear is more compact, both the central spike and the branches being ear-like in appearance. It remains to be shown that these two abnormalities are genetically distinct.

Crosses of Tassel Seed with Tassel Ear.—If tassel seed and tassel ear were fundamentally identical, differing only in density of the inflorescence, vigor of growth, and the like, somewhat as strains of normal corn differ, crosses between the two should give pistillate flowered plants. Of course it is impossible to cross two wholly pistillate flowered types directly, but no mere fact of this kind need bother us long. Conclusive evidence can be obtained from crosses of normal plants, the one heterozygous for tassel seed and the other for tassel ear. Or, better still, a plant heterozygous for one recessive type may be crossed with the other recessive.

If the two recessive types were the same, the cross of two heterozygotes should give 25% of pistillate flowered plants in the progeny. Or, on the same assumption, if an F_1 plant heterozygous for tassel seed is crossed on to a tassel ear and a plant heterozygous for tassel ear is crossed on to a tassel seed, 50% of the progeny should be pistillate flowered. All these crosses have been made and progenies grown. The cross of the two heterozygotes yielded 69 normal plants. A normal plant heterozygous for tassel seed crossed on to a tassel ear gave 40 normals, and a normal plant heterozygous for tassel ear crossed on to a tassel seed resulted in 33 normals. Not a single pistillate flowered plant appeared among the 142 normals. This is regarded as conclusive evidence establishing the genetic distinctness of the two pistillate flowered types. What the double recessive will be like cannot be told until another generation is grown.

Distinct Linkage Relations of Tassel Seed and Tassel Ear.—The story of the linkage relations of tassel seed and tassel ear is only partly known, but sufficient information is at hand to prove that the two abnormalities show distinctly different linkage relations with certain other factors of the maize plant.

A back cross involving tassel seed, *Ts ts,* and a factor pair for pericarp color, *P p,* gave 81 normal plants all with red pericarp and 77 tassel-seed plants all with colorless pericarp. The pair *Ts ts* is, therefore, very closely linked with *P p* or the two pairs are identical. In a similar back cross involving *P p* and tassel ear, *Te te*, there appeared normals with red and with colorless pericarp and tassel ears with red and with colorless pericarp. There were 50 plants of the parental combinations and 56 of the other two combinations of the two characters in question. This is a "crossover" percentage of 52.8, or a deviation from 50 of 2.8 ± 3.3. Apparently, therefore, tassel ear is not linked with pericarp color. Certainly it does not show the same linkage as tassel seed.

It has long been known that a recessive leaf abnormality called liguleless *Lg, lg,* is linked with a dominant plant color called sun red, in which the factor pair *B b* is involved. The crossover percentage commonly observed is about 30. A back cross involving *B b, Lg lg,* and tassel ear, *Te te,* produced 96 plants with all but one of the eight possible combinations of these three factor pairs. The crossover percentage for *B b* and *Lg lg* was 29.2, for *B b* and *Te te* 20.8, and for *Lg lg* and *Te te* 45.8. The crossover percentage for liguleless tassel ear is so near 50, deviation 4.2 ± 3.4, that, standing alone, it affords no satisfactory evidence of linkage. There can be little doubt, on the other hand, that *B b* and *Te te* are

A VERY COMPACT FORM OF TASSEL SEED

Even in this extreme form the spikes are hardly ear-like. (Fig. 15.)

TWO MATURE TASSEL EARS

The central spike and the branches are very like small ears. This is seen particularly well in the poorly pollinated specimen (left), and fairly well in the other one, from which birds have removed many seeds. (Fig. 16.)

linked, the deviation from 50% (independent inheritance) of 29.2 ± 3.4 being of such a magnitude that it would not be expected to occur by chance more than once in millions of trials. Moreover, there was in this back cross no great deficiency of tassel ear to mask the results, since the normals were to the tassel ears as 53 to 43. Again, the numbers of all the several classes were very close to expectation on the basis of the crossover percentages noted. Of the 96 plants, 50 were non-crossovers, 44 single crossovers, and 2 double crossovers.

Unfortunately there are no data available at present with respect to the possible relations of *Ts ts* with *B b* and *Lg lg*. There are, however, back cross data including no less than 3,700 plants involving *P p* and *Lg lg*, and 2,600 involving *P p* and *B b*, all without any indication of linkage. It follows, therefore, that tassel seed and tassel ear are not only distinct genetically as well as morphologically, but that they belong to distinct linkage groups.

Identifying the Double Recessive, Tassel Seed Tassel Ear.—It is not known what sort of plant the double recessive, tassel seed tassel ear, will be. There is available abundant material, in some of which *ts ts te te* should appear next season. If it should prove to be like one of the types described in this paper, tassel ear for instance, a 9 3 : 4 relation should be found to exist between the three phenotypes. Ordinarily, in such a case as this, it is necessary to conduct further breeding tests in order to distinguish the phenotypically alike, but genetically different single and double recessives. But such tests might here encounter serious difficulties. The most likely procedure, in case the double recessive is not distinguishable from one or other of the single recessives, is to cross random samples of the recessive plants with *both* heterozygous tassel seed and heterozygous tassel ear. This would involve considerable difficulty unless two true ears or one ear and the terminal inflorescence develop on each plant, a thing hardly to be expected in plants so weak as tassel ear. Of course it would doubtless be possible to make up the two classes of heterozygotes so that they differ from each other and from the recessives by dominant aleurone or endosperm characters. A single ear of each recessive could then be pollinated by both heterozygotes and the resulting seed separated into two lots corresponding to the two heterozygous parents. But all this would require much time and no little effort.

Fortunately, no such tests should be necessary in the particular case under consideration. The known linkage relations of tassel seed and tassel ear with other characters should make the solution of the problem much less difficult. To emphasize the aid that some knowledge of linkage affords in such a problem as this is the only excuse that the writer can plead for this attempt to cross an apparently difficult bridge before he is sure that such exists. It will not be difficult to introduce both *P p* and *B b* into the cross of tassel seed and tassel ear. Any resulting pistillate flowered plant with colorless pericarp is almost certain to be *ts ts*, and there are about four chances in five that any pistillate flowered plant having the factor of the pair *B b* present in the tassel-ear parent of the tassel-seed tassel-ear cross will also be *te te*.

EUGENICS AND OTHER SCIENCES

Some Comments by Frederick Adams Woods on an Article in the Eugenics Review

THE *Eugenics Review,* which is the official organ of the Eugenics Education Society of London, contains a comprehensive and suggestive article on "The Relations of Eugenics to the Other Sciences," by Harry H. Laughlin.

In regard to genealogy the author says: "Genealogies and biographies have existed since civilization began. At present the genealogist strives to work out the family net-work, giving the names, dates, and connections. He is often content to stop there. The task of eugenics is to prevail upon all of these workers to provide a description of the natural, physical, mental, and temperamental qualities of each member listed in the net-work. When this is done, the genealogist supplies a record of practical pedigree-value, one which can be used in tracing the descent and re-combination of natural qualities within the family-tree."

The author's remarks on the relation of eugenics to biography are open to some question. "The history of mankind is equivalent to the biographies of all of its human units. The different weights that different men have supplied in making history is so vast that we often shorten the statement by saying that 'the history of the race is the biographies of its great men.'"

This is very likely true, but the relations of great men to the ages in which they have lived are doubtless reciprocals, and many writers contend that great men are largely the products of their times. There has been but little done in the way of systematic and quantitive study on this problem. What little research there is, points towards the view that great geniuses are born as such, and lead the way in creating new epochs. More investigations are much to be desired.

The author's following statement we take exception to, simply because we do not believe that it is at present practical: "The eugenicist has the task of convincing the writer of biographies that one of his principal duties in the description of the life of his subject is to resolve the factors of nature and nurture—to evaluate the effect of specific hereditary traits in making the human machine that turned out the specific product which he is describing as a life's contribution to history."

It is not possible for a biographer, or historian, or indeed any writer, even if he be equipped with the utmost scientific knowledge, to resolve in any one individual "the factors of nature and nurture" or to "evaluate the effect of specific hereditary traits." This can be done only when large statistical totals are available, and then only when special schemes have been devised. Any assertion that such and such a trait was inherited from such and such an ancestor, or that such and such a characteristic was "clearly the result of early influence," etc., etc., is not only pure dogmatism, but it is often pathetically naïve.

Some day we may know so much about the limits of heredity and environment, *in general,* for all kinds of specific traits, both mental and moral, that we can rightly suppose that what is true in the general is probably true *in the individual;* but for the present it is idle for the biographer to do more than carefully trace the complete immediate pedigree of his subject in all its ramifications and to record as many as possible of the facts. These facts can be made the bases of statistical inquiries.

In regard to sociology the author says: "There is a tendency on the part of sociologists to ascribe practically all of the factors of human destiny to

matters of environment. On the other extreme we cannot, of course, ascribe everything to heredity. The great problem now, as always, is to make a true analysis of human reactions, ascribing to environment its true forces, and to hereditary qualities which react to environment their due weight. No headway can be made in claiming undue weight, either by biology or eugenics, for heredity, or by sociology or euthenics, for environment."

We should say that perhaps a certain amount of headway may be gained even if an *undue* weight be given to heredity on the one hand or environment on the other. But it will be only the headway that springs from controversy. The true and scientific headway should be the evaluation of changed environment when acting upon comparatively identical germ plasms, and the evaluation of differing germ plasms when nourished in comparatively identical environments. It should be insisted upon that we already know, from the confirmatory results of a number of researches, that, as far as important human differences are concerned, these differences are probably the result of differences in the chromosomes of the primary germ cells.

THE DEATH OF RICHARD SEMON

PARTICULARS regarding the death of Richard Semon, author of the mnemic theory of heredity, are given by his intimate friend, August Forel, in a recent issue of *La Libre Pensée Internationale.*

Born in Berlin in August, 1859, Semon studied zoölogy with Ernst Haeckel at Jena and secured the degrees of Ph.D. and M.D. Then, Dr. Forel recalls, "he made a trip to Africa, studied at the zoölogical station in Naples, became assistant to O. Hertwig, and finally *privat docent* in anatomy at Jena.

"After being made professor extraordinary in 1891, he undertook, with some aid from P. de Ritter, but mainly at his own expense, a trip to Australia and the Malay archipelago, to study the most primitive mammals and the pulmonary fishes, their manner of life, their structure, and their development. It is enough to say (I cite Lubarsch) that in twenty years seventy-seven different savants have published six huge volumes in folio with 343 plates and 1,810 text illustrations, in 112 different lines of research, on the scientific results of Semon's voyage; one can thus understand the enormous amount of work he accomplished in the antipodes.

"He himself wrote in 1895 (second edition in 1903) a narrative of his journey entitled, 'In the Australian Bush,' published by W. Engelmann, Leipzig. This narrative is captivating in the highest degree, as much from the scientific point of view as from that of human interest. In it Semon shows all the delicacy and depth of his feelings, as much as the clear, perspicacious and assimilative genius of his investigative spirit. I strongly recommend a perusal of this book to every person with a little education.

"In 1897 Semon left Jena and his professorship to go to Munich. In working over his Australian material, he reflected on the great problems of biology, on the problem of life. Realizing how idle the sophistic disputes between 'vitalists' and 'mechanists' remained as long as the origin of heredity was not clearly understood, he gave himself up to a profound study of the latter and of its relation to the characteristics acquired during every individual life, vegetative and cerebral.

"With a flash of genius, Ewald Hering had remarked, 'Instinct is analogous

to a memory in the species.' But he was laughed at, and gave up instead of developing his idea. Taking up this suggestion from Hering, Semon tested the question by a study of the effect of irritations on living matter, and the persistence of this effect as an 'engram,' either directly in the cells or indirectly through the nerves and the brain; not only in the individual, but, passing through the germ-plasm, in heredity.

"Thus in 1904 he came to write his fundamental work on the 'mneme' as the conserving principle of organic life; and in 1909 followed a supplement on 'mnemic sensations' in which the terms 'engram,' 'ecphory,' 'homophony,' and the like were applied to the heredity of all living beings as well as to human mentality.

"Persons as small as they are superficial, slaves of prejudices and phrases, have been unable to see in all this anything more than 'new names for old ideas,' when as a fact their own lack of ideas—that is, the routine of their old psychology and biology—was overthrown from top to bottom by Semon."

"In addition," Dr. Forel continues, "Semon had clearly proved the inheritance of acquired characters (which amount to the 'mutations' of de Vries) by his researches on the origin of the sole of the human foot, etc. Moreover, he prepared during recent years a book on the pathology of the mneme, which I would rejoice to see published. But he had suffered profoundly from the death of his wife, which occurred in 1918. He cherished her the more because, having no children, they worked together. In addition, Semon, a declared foe to all chauvinistic hatred between peoples, had suffered deeply from the war.

"On December 27, 1918, the day on which he shot himself, he wrote me the following letter:

"'My very dear friend, it is to you that I write my last letter. I strongly suspect that you will blame me for voluntarily ending my life. I would not have done so—I would have sought and found in my work the needed strength, strength which I possess, to endure the atrocious isolation in which I was plunged by the death of my wife, the incomparable companion of my existence. We lived together in the loftiest mental intimacy. But work has become impossible to me, for my mind, especially its mneme, is failing more and more. In others, that begins only at the age of eighty; with me, twenty years sooner. In this domain I am marked by heredity.

"'Having tasted of the fruit of the Tree of Knowledge, and noticing in myself the first traces of evil, I do not wish to stain the work of my life by a termination of inferior value. On the other hand, I cannot exist without work.

"'Having no one to support, I leave no vacancy. Forgive me, then, in understanding me.

"'I owe you much, dear friend—stimulation of ideas, great encouragement of my efforts and of my achievements. I leave my last work, 'Self-consciousness and Brain,' half finished. But as it clearly contains, in my opinion, a useful nucleus in the first six chapters, already completed, I have arranged for its publication, at least as a 'torso.' I regret that I shall no longer be able to have your counsels on this work.

"'Adieu! May you and yours live happily. My heart remains full of esteem and gratitude to you.

"'Your faithful

"'R. SEMON.'"

In the early years of its appearance, Semon's theory attracted much attention in the biological world. While it gained a number of eminent adherents, most geneticists considered it highly mystical in nature and attached little value to the experimental and other evidence which its author cited in its support. In recent years not much has been heard of it.

A DISCUSSION OF POPENOE AND JOHNSON'S "APPLIED EUGENICS"

AND THE QUESTION OF HEREDITY VS. ENVIRONMENT

MR. PAUL POPENOE,
Washington, D. C.
DEAR SIR:

Your publishers have been kind enough to send me a copy of "Applied Eugenics," by yourself and Professor Johnson, and I have been reading it with a great deal of interest and satisfaction. I was a student of Galton many years ago, and have since, from time to time, read such works on eugenics as seemed most significant. I have always given the subject a large place in my teaching and have regarded it as of equal practical importance with sociology proper.

Your book I think much the best that has appeared for my purposes, and mainly for two reasons. First, it contains a much larger body of well-considered social applications, and, second, there is evident throughout a non-partisan spirit and a desire to come to an understanding with students of the social sciences. It is especially in this latter connection that I have felt inclined to write you.

Without doubt eugenics has as yet made a far slighter impression upon students of the social sciences than its intrinsic importance entitles it to make. Why is this? While mere ignorance may largely account for it, I think that with intelligent people an equally important factor has been the narrow and particularistic spirit in which eugenics has commonly been advocated. The eugenists have seemed not so much to be proposing a line of research and practice supplementary to history, economics, sociology, education and the like, as striving to depreciate and practically to supplant these branches of learning. A specialist in one of them would take up a book or article on eugenics and, observing that the class of facts with which he was most familiar were ignored or scoffed at, would naturally conclude that the author was some kind of a crank whose ideas could have no serious interest for himself.

There has been ground for this impression, it seems to me, even in the case of the ablest eugenists. Take Galton, for example. I would not call anything that he wrote sociology, properly speaking, or admit that he saw anything from a sociological standpoint. He collected facts of individual and family biography to throw light on his biological theories, but I do not think he ever shows that *conception of social organization and development as a living whole* which, I should say, was the essential thing in sociology, or, for that matter, in history, economics, etc. Accordingly learned and open-minded men, like James, Bryce and many others, were unfavorably impressed with his views and perhaps did them less than justice.

I take it that the misunderstanding between biological and social science is one that can hardly be healed by an appeal to specific facts, because it rests rather on a difference in the presuppositions, the points of view, hypotheses and problems which control the perception and interpretation of facts. I seldom quarrel with the facts put forth by a eugenist, but can very often see an entirely different interpretation of them.

Now let me make one or two constructive suggestions. I think one thing necessary is a clearer fundamental theory of the underlying relation between the social and biological processes, in which, perhaps, might be found a

[1] "Applied Eugenics," by Paul Popenoe, former editor of THE JOURNAL OF HEREDITY now Gen'l Sec'y American Social Hygiene Assn., and Roswell H. Johnson, University of Pittsburg. Pp. 459, with illus., charts, etc. MacMillan & Co., New York, 1918.

basis upon which students of both might build.

The overworking of the "nature *vs.* nurture" antithesis has done incalculable harm in giving the discussion a partisan character. It should be supplanted, I think, by the conception that there are two parallel and interrelated processes, the biological and the social, equal in importance but quite different in character, supplementary to each other and not, properly speaking, in opposition to each other at all. The chief seat of the former is the germ-plasm; of the latter, the stream of psychical communication through which social organization and development take place. Sociologists, economists, historians, jurists, political scientists, social workers and the like are primarily engaged with the latter, which (let biologists note) is a real system of organic life and not a mere "environment" of the germ-plasm. But as their whole process, biologically speaking, is founded on the germ-plasm, they must study eugenics.

In a similar sense the biological process is based upon the social, which in general determines the environment in which the germ-plasm lives and, more particularly, the conditions of selection which favor some types and suppress others. Eugenists, then, should study sociology.

I think it should be recognized, also, that human heredity is, in general, far more plastic than that of the lower animals. I mean, not that the principles of heredity are different, but that the characters inherited are themselves, for the most part, plastic—teachable instincts instead of rigid, for example. A recognition of this would abate many controversies, reconciling, largely, the sociologist's faith in education with the eugenist's conviction of the impossibility of changing inherited traits. This principle is, of course, good Darwinism, and you recognize it on page 406, where you say "All that man inherits is the capacity to develop along a certain line under the influence of proper stimuli . . ."

I may add that a book I have recently published ("Social Process," Charles Scribner's Sons) contains four chapters dealing with Social Factors in Biological Survival which deal somewhat more fully, though inadequately, with this line of thought. If you care to review these chapters, or the whole book, in the JOURNAL OF HEREDITY, I have no doubt the publishers will send you a copy for that purpose.

Let me say again that I have read your book with profit and that I find myself agreeing with most of what you say relating to "the eugenic aspect of specific reforms."

Sincerely yours,
CHARLES H. COOLEY.

JOURNAL OF HEREDITY
Washington, D. C.,

PROFESSOR CHARLES H. COOLEY,
Ann Arbor, Mich.

DEAR PROFESSOR COOLEY:

Mr. Popenoe, has forwarded to me your letter to him on the subject of his book, "Applied Eugenics." If agreeable to him and to yourself, I should like to publish this letter in the JOURNAL OF HEREDITY, or perhaps the greater part of it, or perhaps you would make this the basis of a more extended review. I think it would be a fine idea to have the heredity environment problem discussed from the sociological standpoint.

For my part I have believed for a number of years that the tangle can only be unravelled by treating both factors as a problem of differences.

This I had an inkling of, but no clear conception of at the time I published "Heredity in Royalty," 1906, for there I sometimes say that 90% is due to heredity. In another place I say that all the rough differences are due to differences in the germ-plasm, in spite of the considerable differences in the environment. This latter point of view is more elaborately worked out in an article published in the JOURNAL OF HEREDITY in 1917, called "Significant Evidence for Mental Heredity."

I do not see that your "stream of psychical communication through which social organization and development

take place" is anything more than a part of what we understand as nurture, or environment. This has varying effects on different functions, more effect on some than on others. It undoubtedly has a great effect on one's modes of speech, and on manners. The question is, how much on each trait or function?

All true scientists should aim, not at a partisan discussion, but at a more measured estimate as to what can be done, and what *cannot* be done by furnishing ameliorative environments.

There have not been as yet more than about a half a dozen researches in this direction, but they undoubtedly foreshadow the future as far as the study of human heredity has a bearing on psychology, sociology, and history.

I hope you may be brought to ponder on this point and see that, by the statistical method, sociologists can slowly but certainly measure the limits of chromosome control.

With pleasant remembrance of former correspondence that we had some years ago (I think it was on my "Laws of Diminishing Environmental Influence," believe me

Sincerely yours,
FREDERICK ADAMS WOODS.

DR. FREDERICK ADAMS WOODS,
Washington, D. C.

MY DEAR DR. WOODS:

I shall be glad to participate in an informal discussion of the general relation of social to hereditary process, so far as I have anything to contribute. I think that, in the lack of an understanding upon this, discussion of detailed questions is mostly futile.

It is true, as you say, that the stream of psychical communication through which social organization and development take place is a part of what biologists understand as nurture or environment. But they should understand also that this, though true from their standpoint, is a wholly biological conception of the matter and not at all that of the social sciences. I mean that it looks upon the germ-plasm and the growth of biological individuals as the central interest and regards social life, so far as it regards it at all, as a surrounding condition, or "environment."

Now for the sociologist the matter is quite turned around. For him social process, social organization and development, is the center of interest. This is a distinct evolution of organic life, of the utmost complexity and human interest, and not only one but many sciences are preoccupied by it. He sees the germ-plasm and other biological phenomena very much as the biologist sees society, as a sort of side-issue, an "environment" (although that word is not used, it might be, logically enough), a mere conditioning circumstance of the evolution with which he is familiar. And he has just as good ground for his attitude as the biologist has for his. One process is not more original and causative than the other. The biological controls the social in a certain sense, in another the social controls the biological.

I feel sure that no statistical studies from the merely heredity-environment standpoint will convince students of the social sciences, because such studies invariably, or almost invariably, involve premises they do not accept. A classic example is Galton's "Hereditary Genius," which seems to a sociologist to beg the whole question in a paragraph or two, in which he asserts that great and enduring reputation may be treated as identical with natural genius.[1]

The only way I see, then, of making a start towards a *rapproachement* is by agreeing upon the parallel and coördinate nature of the two life-processes, each party endeavoring to get the general point of view of the other, and then proceeding to investigate the large class of questions in which they are both involved. But this will be very difficult, because habits of thought are not likely to be changed by argument.

I think, however, that the latter part of Popenoe and Johnson's "Applied

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[1] Enduring reputation is certainly not identical with natural genius, but the two are to some extent correlated. To determine the approximate amount of this correlation would make interesting subject for research.—F. A. W.

Eugenics" is much more reconcilable with the sociological point of view than anything else I have seen, from biologists, covering similar ground.

I am quite willing that you should publish any part of my letters that you think may interest your readers.

Sincerely yours,
CHARLES H. COOLEY.

NOTE BY F. A. WOODS.—By way of further discussion I should only like to make three further comments.

1. I agree with Professor Cooley in his idea that a social group may be regarded and studied as if it were a biological organism, but this idea does not prevent us from measuring the differences between individuals who compose the group and attempting to devise means of studying the various reactions of the group or the individual.

2. I do not agree at all with Professor Cooley's statement that "human heredity is far more plastic than that of the lower animals," as I have already shown the truth to be quite the contrary by an analysis of the degrees of artificial modification obtainable in the organic series of plants and animals. This is the above cited "Laws of Diminishing Environmental Influence."[2]

3. I fully agree with Professor Cooley when he says that habits of thought are not like to be changed by argument. No, not by argument which in the past has been too much the method of the sociologist but by measurements and by inductive science which has only recently become the method of the biologist, the psychologist and the philosopher of history.

The Eugenic Bearing of Taxation

Assessment of an income tax by dividing the total income of a family among all the members, old or young, and taxing each separately, is recommended by a committee of the Eugenics Education Society (London), headed by the president, Leonard Darwin, which has been submitted to Parliament.

As a conclusion to the discussion, which is printed in the January, 1920, *Eugenics Review*, Major Darwin prints the following summary:

"Taxation should fall on parents and on the childless in proportion to their ability to bear the strain. To make the incidence of the income tax just, the amount thus now obtained from the childless should be increased and that from parents decreased, the transfer of wealth thus affected should bear some relationship to the income taxed, and consideration should be given to the distinction between wealth which has been won by the individual taxed and wealth which he has inherited. Smaller incomes being less taxed, to allow the family income to count as several separate incomes would produce the desired differential result, though, in order not to diminish the revenue, the rate per pound would have to be raised in all grades. If such a reform cannot now be fully adopted, the principles involved should, we urge, be authoritatively sanctioned, and when in the future taxation can be lowered, it should first be materially lowered on parents before any burden is taken off the childless. The winning of a moderate income by their own work, the saving and conversion into capital of some of this income, a saving needing care and self-sacrifice, the preservation of this capital in succeeding generations in consequence of thrift, temperance, and perseverance—these have been different steps in the history of the creation of that part of the nation which would be affected by such a reform. Where any of these conditions exist, there the stock must generally be sound, and the nation demands a relatively more rapid multiplication of its soundest stocks."

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[2] *Popular Science Monthly*, April, 1910, pp. 313–331.

Variation of the Palm Weevil

While collecting in the vicinity of Daytona, Fla., April 5 to 9, 1919, I made two visits to a freshly cut cabbage palmetto stump, the sap of which had started to ferment, and captured ninety-two specimens of the palm weevil (*Rhynchophorus cruentus* Fabr.). This large series was taken to show to what extent the species varies both in size and color. The males are readily recognized, regardless of size and color, by the noticeably thicker and roughened beaks or rostra. The following figures show that size and color are in no way sexual characteristics and that those referable to the two larger groups are remarkably uniform in numbers, while those that might be termed strictly intermediate are comparatively few. The entirely black form is known as variety *zimmermanni* Fabr.

TABLE OF COLORS

Entirely black 38 specimens—20 males and 18 females.

Red present to a greater or less extent on the rostrum, thorax, elytra (wing cases), legs and the basal and anal segments of the abdomen, 42 specimens (21 males and 21 females).

Thorax and elytra both slightly marked with red, legs entirely black, 6 specimens (3 males and 3 females).

Thorax only slightly marked with red, rostrum and tibiae reddish, 5 specimens (2 males and 3 females).

Elytra only slightly marked with red, legs black (1 female). Total, 92.

TABLE OF SIZES

Smallest specimens, males and females, 28 mm.

Largest specimens, males and females, 36 mm.

Not exceeding 30 mm., 14 males and 16 females; entirely black, 7 males and 7 females; marked with red, 7 males and 9 females.

Exceeding 30 mm., 32 males and 30 females; entirely black, 13 males and 11 females; marked with red, 19 males and 19 females. Total, 92.

EXPLANATION OF PLATE

First row: 1, 2 and 3 males; 4 and 5 females.

Second row: 1, 2, 3 and 4 males; 5 females.

Third row: 1 and 2 females; 3, 4 and 5 males.

Fourth row: 1 female; 2 male; 3, 4 and 5 females.

This series shows practically a complete gradation between an almost red specimen (the first in the series) and the pure black specimen at the end of the last row.

CHARLES W. JOHNSON.
Boston Society of Natural History,
Boston, Massachusetts.

The Meaning of Continuous Variation in Color

It is rare to find in the animal world an example of perfectly continuous graduation in a color pattern, and all within a single species inhabitating a single locality. What is the meaning of the remarkable series? There seems to be a mystery here. Something for the mutationist and protective coloration experts to pay attention to. Are these beetles, (*Rhynchophorus cruentus*), in the process of acquiring a camouflage or are they losing their red color pattern and becoming all black, like the last of the series? Perhaps the color has nothing to do with survival value, and merely varies through some direct influence of the environment, to which surface pigmentation is usually extremely susceptible. If so, why should they differ so much although living in a presumably uniform environment?

It does not seem that Mendel's laws of heredity find a practical illustration here, since besides these 20 shown in the plate (Fig. 17), the other 72 in Mr. Johnson's collection are quite as impossible to place in any two categories, one

CONTINUOUS VARIATION IN A SINGLE SPECIES

These are specimens of the palm weevil. The color pattern, which is dark red, has been here painted white. Such continuous variation in color is rarely found among insects. Its meaning is discussed on the opposite page. (Fig. 17.)

of which shall be a D and the other an R. It would at least require the postulation of so many determiners that Mendel's laws would fail to have a pragmatic value. Still, the series is not an example of unimodal variation since the most common types are not those of the two middle rows, with "entire black" of rare occurrence. Nearly half of all the specimens are entirely black, 38 out of 92 in Mr. Johnson's figures. It would seem that these beetles may be the result of a cross between a colored variety, similar to the first specimen, with a black variety as seen in the last specimen.—F. A. W.

A Study of Country Children

That children from a good farming district are more intelligent than children from a poor rural district in Indiana is the conclusion of S. L. Pressey and J. B. Thomas, who present their study in the Sept., 1919, issue of the *Journal of Applied Psychology.*

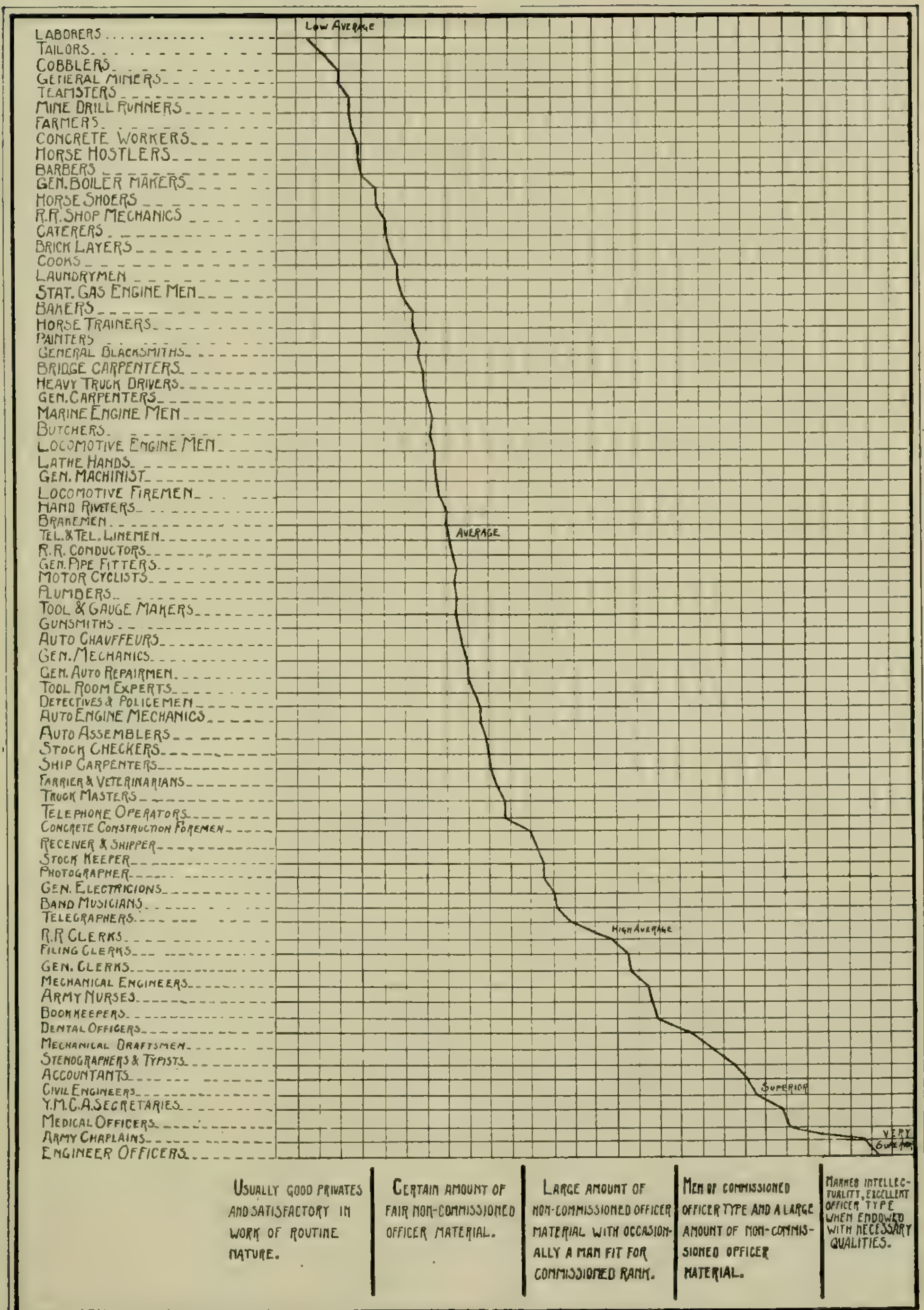
"It is not infrequently asserted," they remark, "that in the country districts a constant selective process is going on, the poorer, less intelligent stock being pushed back more and more into the hill country where the land is poorest, while the more able, assertive elements of the population obtain the best land and the best opportunities. That is, on this assumption, there should, in an agricultural community, be a positive correlation between land values and intelligence."

The assumption is definitely upheld by the results which the writers secured; but they also found that all the country children whether from prosperous or backward districts, averaged below city children in intelligence.

Measuring Intelligence

Next to physical fitness, intelligence is perhaps the most important single factor in a soldier's efficiency. So says a pamphlet entitled "Army Mental Tests," published in November, 1918. Mental tests prepared by a committee of the American Psychological Association and of the National Research Council were given to recruits during the two weeks immediately preceding their entrance into the Army. The ratings which these men earned furnished a fairly reliable index to their ability "to learn, to think quickly and accurately, to analyze a situation, to maintain a state of mental alertness and to comprehend and follow instructions. The score is little influenced by schooling. Some of the highest records have been made by men who had not completed the eighth grade."

The tests were not, however, the full measure of a man's value in the military service, nor did they prove that men of equal mental rating were necessarily of equal military worth. Such qualities as loyalty, bravery, power to command, and the other traits which go to make up a good soldier, could not be measured by this test of intelligence. In the long run, however, those traits are more likely to be found in men of supeior intelligence than in men who are intellectually inferior. That a man's value in the military service could not be judged by a test of intelligence alone has been shown by the fact that many of the men who earned only low mental ratings in the tests made good in actual practice in positions of responsibility. Nevertheless the intelligence rating was found to be one of the most important aids in the selection and assignment of men to the specialized tasks of the Army. The accompanying chart graphically illustrates the occupational intelligence standards based on data for approximately 36,500 men.



MENTAL RATINGS OF 36,500 MEN CLASSIFIED ACCORDING TO OCCUPATIONS

Mental tests were conducted by the Army to aid in the selection, classification and assignment of men to particular tasks requiring rapid adjustment. The tests of course could not tell infallibly what kind of soldier a man would make, but they were very useful in indicating his probable value to the service. (Fig. 18.)

THE DEVELOPMENT OF USEFUL CITIZENSHIP

It Is Not Enough to Maintain the Standard of the Human Race at Its Present Level—Public Opinion Now Recognizes Need of Producing Better Racial Stocks

Hilda H. Noyes, M.D., *Kenwood, N. Y.*

IN order to bring about any real and lasting improvement in the quality of a given population, it is necessary to recognize not only the need for cutting off the defective lines of descent, but the positive side of the problem: that of increasing the production of the more worthy strains.

There should be a judicious and necessary diminution of births among those who have the least physically, mentally, morally and economically with which to endow their children. Restrictions should be placed more stringently on those furthest removed from useful citizenship, so that the proportion of the unfit would tend to decrease in each succeeding generation.

The need for cutting off the defective lines is coming to be understood and appreciated. Some practical steps to accomplish the desired result are being taken, which show the trend of public opinion and will lead to further accomplishment in the same direction.

But the cutting off of defective lines alone will only serve to maintain the standard at its present level. Conklin states in his "Heredity and Environment," p. 425, "If only the very worst are eliminated in each generation, the standard of a race is merely maintained." In order to raise the standard it is necessary to greatly increase the birth and survival rates among those above mediocrity who are the useful citizens of today.

The factors which have acted both directly and indirectly to reduce the productivity of our most gifted and prosperous members of society, should be investigated that measures may be directed toward removing the cause.

Some practical influences may be brought to bear, under present social conditions, which will help to bring about a differential fecundity in favor of the better stocks.

Let us consider first, relief of the over-burdened mother with a further development of the creche or day nursery, and a possible extension service into the homes. The responsibilities of the mother might be sufficiently relieved so that no greater effort would be required for the care and up-bringing of three children than she now expends on two. (See Note A.)

In order to convince the well-to-do of their responsibility for the future development of the race, a great educational compaign should be inaugurated. Recognition and the bestowal of honor upon the parents of superior children might tend to augment the birth rate in this group.

HOPE IN THE GREAT MIDDLE CLASS

However, it is neither extreme of the economic ladder which is the hope of the future, but that great mass of useful citizens between these extremes. Rational methods of increasing the fertility of the more worthy strains in the different income groups of this great middle class should be considered.

As the economic aspect has the widest bearing, some form of prize or bonus for the greatest number or the best conditioned children has been among the first measures advocated, but the amount has usually been entirely in-

adequate and the method has been open to the objections raised against all forms of bribery.

Dr. Saleeby, in his, "Method of Race Regeneration," mentions three precautions to be observed in giving financial aid to parents;

"First, the help is not to be a bribe.

"Second, it is to be specific, definitely reaching the point toward which it is aimed, and

"Third, it is to be steady and continuous like the child's needs."

It might be possible to form a Parents' Mutual Protective League in such a manner as to comply with all three of Dr. Saleeby's requirements, with a fourth stipulation added—that the applicants be required to measure up to a certain standard as regards heredity as well as physical, mental and moral development.

If 92 children are born annually per thousand women between 15-45 years, as was the case in 1913 for New York City, we may say roughly that one woman in ten between 15-45 years has a child each year.

Let us suppose that the entire ten families should be willing to pay a small sum annually to form a protective fund so that the annual payment of all ten families would go as a benefit to the one family that was productive that year, to cover the unusual expenses at child-birth and during confinement, as well as smaller sums at stated intervals afterward.

The increased expenses would thus be carried by a group instead of being met wholly by the productive parents concerned.

The benefit payment could not be considered a bribe, or in the light of charity, because the beneficiary would also be one of the contributors.

EXTENSION SERVICE IN THE HOME

It would be specific, reaching the point toward which it was aimed, if administered carefully by the agent of the proposed society, especially if in connection with prenatal work and the follow-up visits of a nurse.

It would be reasonable to expect a reduction in the number of still births and in the loss of life in early infancy from accidents and complications which may thus be avoided. Also maternal mortality should be influenced for the better.

The benefit could be steady and continuous or just to cover the lying-in period as arranged for and desired.

Compliance with the fourth stipulation would give the plan eugenic value as it would open the way to increase the birth and survival rates among those now shaping the thought and controlling the affairs of the nation. It is well known that our captains of industry, statesmen, soldiers, writers, scientific and professional classes are not perpetuating their strains in sufficient numbers to keep their stocks intact.

A recent number of the JOURNAL OF HEREDITY reported an investigation of the California Society of Mayflower Descendants showing the utterly inadequate fecundity among its members.

The somewhat spectacular statement was made that if the present rate of less than two children per family should continue for another three hundred years, it would be possible to put all of the descendants of that rare stock into a boat no larger than the Mayflower without overcrowding. If this reproductive rate can be taken as a criterion of the superior stocks throughout the country, it is none too soon to sound the clarion note to awaken a widespread interest and consideration of what practical steps may be taken along constructive lines to prevent racial decay.

In order to keep a stock from actual decline in numbers, Robert C. Sprague has shown that there must be an average of 3 7/10 children per fertile family to assure the raising of at least three children to marriageable age.

EFFECT OF INCOME ON FAMILY LIFE

The relation between the amount of income and the number of children in a family is definitely known. It is certain that an inverse ratio exists in most

sections of our country today; in a general way statistics show the larger families to be associated with the smaller income groups and vice versa.

It is shown by the 1918 report of the Federal Children's Bureau that the death rate of infants under one year is very closely correlated with the earnings of the father. Where the father receives less than $550 yearly, one baby in six does not reach its first birthday, while only one in sixteen dies before reaching one year where the father earns as much as $1,250. The economic status of the family has a very important bearing upon the number of children surviving in any one group.

The average amount that the family "budget" is increased by the advent and support of each additional child in the income groups between $800 and $2,000 has been determined by the valuable research of Wm. F. Ogburn of the Bureau of Labor Statistics. The equations which he has formulated should prove very helpful in determining the average expenditure for different commodities for families of varying sizes within the stipulated incomes. (See Note B.) Further research may be required to determine similar averages for the higher income groups.

It seems reasonable to suppose that the expenses after the lying-in period for the first child, would not quite return to the amount expended to support the parents alone; and so, with the second, third and subsequent children, the total amount spent should be greater than when the family was one less in number, if the established standard of living is to be maintained.

The dues to form the protective fund would have a certain definite relation to the economic status of the family; the income group receiving from $500 to $1,000 yearly would have a low annual fee to pay; the next group receiving from $1,000 to $1,500 would contribute a slightly larger amount and so on. Or groups may be formed by bodies of people with like interests, such as teachers, college professors, various clubs and societies organized for other purposes, as well as young professional and business men who might adapt this plan to meet their needs and thus enable them to enjoy a protected parenthood among their most worthy members.

It would be possible to develop the plan on broader, more comprehensive lines, if eligibility for membership could be in several classes—associate, active, and supporting.

Associate members would pay an annual fee of $2 and would receive bulletins and other printed matter that was issued.

Active members would pay an annual fee proportionate to income, and would be the only class of members to participate in the benefit.

Conceivably, many who are economically independent and deeply interested in the advancement of the race, might become supporting members contributing $1,000 or more. These could be known as "Founders;" contributors of $500 could be "Patrons," and those paying $100 "Benefactors," etc.

If the income from the above sources permitted, a Foundation for the Promotion of Rational Parenthood could be developed with departments for Research, Education of Public Opinion, and a magazine devoted to such subjects as Eugenics, Child Welfare, Public Health, Sex Education, Voluntary Parenthood etc., all tending directly or indirectly to advance the cause of race betterment.

What more fitting memorial to Roosevelt could be erected as a tribute to his ideals, than an institution of this sort?

In order to safeguard earners against the disquietude caused by a rise in the cost of living, such as that through which we have just been passing, it is advisable to adopt measures, by means of which adjustment of wages to the cost of living is more or less automatic. (See Note C.)

WAR'S DRAIN ON WORTHY STOCKS

The recent war, with the inevitable loss of many choice strains of young manhood, has shown the necessity of constructive effort to increase the fertil-

ity among the remaining worthy strains. It may and should do much to arouse public opinion to support measures directed toward the building of a sounder, saner, more enlightened race.

Note A

A great step toward the solution of the problems of the care and training of children under school age would be taken, if there could be a development of the creche or day nursery as a department in our public school system, in such a way that young children could be cared for for an hour or for the day.

A training school for trained mothers' assistants could be developed in connection with the creche, with a force of doctors, nurses, kindergartners and child psychologists to instruct in the care and feeding of infants as well as their physical and mental development, by games, exercises, stories etc. The trained mothers' assistant would not be a governess, trained nurse, or kindergartner, but would partake a little of all three, so as to be thoroughly competent to care for healthy children under school age.

It would be an advantage if the course of study could be standardized by the Board of Regents and a diploma awarded. Thus a new and dignified profession for women would be developed.

If this course should be given in an intermediate year between grammar and high school, every girl leaving school would have a legitimate means of earning a livelihood, and the plan would have a far-reaching effect, not only in better care of the babies of this and the next generations, but it might aid in the solution of social problems as well.

Note B

See, "Financial Cost of Rearing a Child" by Wm. F. Ogburn, Bureau of Labor Statistics in the "Report of the Children's Bureau Conferences May and June 1919." Bureau Publication No. 60, p. 26.

Note C

One firm in Central New York has instituted what is called the High Cost of Living Wage Plan after considerable study and investigation. They put the following plan into effect in January 1917 after a liberal raise in wages had already taken place.

They selected Bradstreet's Index Number as a basis for calculations, as that figure formed as it is from the average of 100 commodity values, such as a ton of coal and a bushel of potatoes, corresponds closely to the actual changes in living expenses and does not make sudden, large fluctuations. The increase during the previous year was determined, and a 1 to 20 ratio adopted so that the percentage for the H. C. L. wage would increase or decrease 1% for each 20-point change in the Bradstreet number, or ¼% for each 5-point change; the changes being made monthly and the Index Number for the preceding month being used throughout the month following. The extra wages were given in a separate envelope known as the High Cost of Living Envelope, the regular wages being given as usual in another.

The percentage of extra wages received was 16% in Jan. 1917. From this point it gradually, but steadily rose until it reached 43½ in August, 1918, which was the highest point for 1918. The fluctuations during 1919 have been from 33¾% in April to 48¼% in December.

The index number being determined by a firm entirely outside of the company is a factor to be considered from its psychologic bearing, as the company itself cannot be held responsible for the fluctuations.

Although this plan, in its entirety, may not be adapted to all forms of business, still, it may be of interest to note that in practice it fully equalled anticipation, and its justice is unquestioned.

INHERITANCE, by Whitfield G. Howell. Pp. 190. Boston: The Roxburgh Publishing Co., Inc., 1919.

It is difficult to say anything for Mr. Howell except that most damaging of all compliments, that "he meant well." He has written a novel to convey to the public the supposed truths of heredity. But almost everything he tells about heredity is incorrect. The book has, moreover, little literary merit.

A MUTATING BLACKBERRY-DEWBERRY HYBRID

L. R. Detjen
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MUTATIONS among the blackberries and dewberries, with the exception of chimeras, have been seldom reported. *Rubus laciniatus* Willd. is considered a cut-leaved form of the European blackberry, *R. fructicosus* L. Whether it originated from a seed or from a mutating vegetative bud seems to have never been recorded. A cut-leaved variety of dewberry of distinctly trailing habits has also found its way to the market and is grown mostly for ornamental purposes, but, like *Rubus laciniatus*, the origin of this dewberry is obscure and only a matter for speculation.

It was the writer's good fortune to discover in the summer of 1915 a similarly cut-leaved plant arising as a bud mutation from what appears to be a wild, natural, blackberry-dewberry hybrid. As this hybrid form is very common in the vicinity of Raleigh, N. C., no especial emphasis need be laid on the probable parental species. The plant was found growing on a high embankment on the railroad right-of-way of the spur that enters the State Fair Grounds at West Raleigh, N. C.

The plant when discovered possessed two canes, one normal, *i. e.*, with entire leaflets, and one abnormal, *i. e.*, with finely divided leaflets (see Figs. 19 and 20). As the plant possessed all indications of possible propagation by means of tip-layers, this method was at once resorted to and two new plants were thus secured.

In the late fall of 1915 the mutating crown was taken up and planted in the station experimental vineyard. The two new plants that were secured by means of tip-layering were planted in the horticultural grounds among five varieties of blackberries and three varieties of dewberries. All of the plants grew and reproduced the divided

THE CUT-LEAVED MUTATION

A one-year old cane showing the finely divided leaflets. (Fig. 19.)

A CANE FROM THE ORIGINAL PLANT

This shows well the arched cane. Note also the self-rooted tip-layer and the undivided leaflets. This plant produced the cut-leaved form by means of a mutating vegetative bud. Greatly reduced. (Fig. 20.)

INTERMEDIATE ATAVISTIC TYPE

This constitutes the first visible atavistic step of the cut-leaved form. (Fig. 21.)

EXTREME ATAVISTIC TYPE

The leaflets on this cane are undivided like those on the original wild forms. (Fig. 22.)

leaflets. The two tip-layered plants in succeeding years continued to reproduce themselves naturally by means of suckers and tip-layers, and these also produced the divided leaflets of the original mutation.

In the fall of 1919, two atavistic mutations were observed growing among the progeny of these plants. By careful study and root tracing, these atavistic forms were found associated only with those plants that had originated as suckers from the roots of one of the original tip-layered plants. One of these atavistic mutations affects the four lower leaflets only, these being entire, while the upper leaflet is more or less divided (see Fig. 21). This form might be termed an intermediate type. The other mutation consists of a complete reversion of all the leaflets to the original undivided form. This is the extreme type (se Fig. 22). All of the leaflets on these later atavistic plants are uniform, and none exhibit the tendency toward segmentation.

From a horticultural viewpoint, these mutations are extremely interesting, and the finely divided leaf forms may even be termed ornamental. The canes normally grow arched, ascending about 2 to 3 feet high with short, leafy flower clusters. The foliage on the young canes appears by far the more ornamental because of the beautifully five-pointed and much divided leaflets. On the fruiting canes the leaves are less divided and less graceful, and therefore such canes ought to be removed soon after the flowering season. Fruit on these mutating plants, especially the cut-leaved forms, is very seldom produced, notwithstanding the abundance of pollen that is borne by the nine different varieties of Rubus that grow in close proximity—in fact within the same row.

Heredity and Environment in the Development of Men, by Edwin Grant Conklin, professor of biology in Princeton University. Princeton University Press, 1919. Third revised edition, Pp. 361, with 101 illus.

When Dr. Conklin's book first appeared in 1914 it met with a warm welcome, but much progress has been made since then in the study of eugenics, and an examination of this latest revision shows that the book has hardly been brought up to date. The principal changes have been made in the chapter on "The Cellular Basis of Heredity and Development," and Dr. Conklin's authority in this field makes what he has to say on the subject welcome. But the sections devoted to eugenics are inadequate at present, and any serious discussion of the application of eugenics is almost lacking. The book is still disfigured by a number of old illustrations that ought not to be allowed to circulate in the present age of photography, though their offense is more esthetic than scientific.

The inadequacy of Dr. Conklin's treatment of his subject is more or less inevitable, since he writes wholly as a biologist, and the study of heredity and environment of men from a purely biological point of view is fraught with great difficulties. A book on the subject, to have much practical value, must be written largely from the biometric and sociological points of view. The author has perhaps made as much as possible out of the material available, but it will be a long while before the purely biological data available on man are sufficient to satisfy an inquisitive reader. Even of the material available, a more rigid selection should have been used, as in the enumeration of characters in man that are supposed to be inherited in Mendelian fashion.—P. P.

AN AWARD OF HONOR TO WALTER VAN FLEET

For His Contributions to the Advancement of Horticulture, Especially Roses, He Is Given the George Robert White Medal of Honor

THE presentation of certificates, diplomas and medals by societies as well as by national and international expositions has been a recognized practice for many generations. Usually such trophies are given in lieu of a money premium in recognition of the excellence or the magnitude of an exhibit.

As early as 1871 the American Pomological Society decided to secure a die for a medal to be awarded as its premium in lieu of cash, and this medal has since been awarded to individuals, firms and societies for specimens or collections of fruit exhibited. Such awards tend to stimulate competition among growers for the coveted prize, the excellence of the exhibit being gauged by the character of the metal used (silver or bronze) in striking the medal.

It remained for Mr. George Robert White of Boston to make it possible for the Massachusetts Horticultural Society, through his gift to it in 1909 of $7,500, to award to the man or woman, commercial firm or institution in the United States or in some other country, doing the most in recent years to advance the interests of horticulture in its broadest sense, the medal known as the "George Robert White Medal of Honor." Every year since its foundation it has been given to workers in the field of horticulture, not because they exhibited a plate of fruit or assembled a large and noteworthy collection of varieties, but rather for the contribution which they as individuals have made to the horticultural world.

So far, two well-defined motives have apparently dominated the ideas of the judges charged with awarding the George Robert White Medal of Honor. One evident motive is to encourage and adequately honor productive horticultural exploration; the other is to encourage the production of new plant forms, particularly orna-

THE GEORGE ROBERT WHITE MEDAL OF HONOR (FIG. 23)

mentals, by means of hybridization. No less than five of the ten medals so far awarded have been given in recognition of achievement in the production of new plant products.

The award of the medal in 1919 was made to Dr. Walter Van Fleet of the United States Department of Agriculture, Washington, D. C., "for advance in the hybridization of garden plants, especially of the rose." The name "Van Fleet" is synonymous with meritorious climbing roses of American origin. In the work of producing roses, Dr. Van Fleet has not been satisfied with a plant that produced a flower of the quality, size and color desired; the production was not complete or satisfactory from his point of view unless the plant possessed a high degree of vigor, hardiness, resistance to disease and abundant bloom. In Silver Moon, Dr. W. Van Fleet, American Pillar, Magnafrano, Rugosa Magnifica, Birdie Blye and Bess Lovett these characteristics are strikingly manifested.

But the crowning achievement in the production of roses is yet to be introduced to the American public. This we believe will be accredited to Dr. Van Fleet when his new Multiflora Rugosa is given to rose lovers who find themselves situated in territory where native wild roses once carpeted the earth with a glory of bloom almost beyond comprehension in its beauty and abundance, but where the horticultural varieties of Europe and the eastern United States languish and die. In the great inland empire of the United States, frequently designated the "Great Plains," these new children of the hardy north European rugose promise to live, flourish and once more restore to the prairie the blush of the rose which it wore as a crown of glory each spring before the advent of the plow. These new forms are notable not only for their flowers but because they are, when not in bloom, shrubs of attractive form and foliage.

No contribution of new plant forms to ornamental horticulture has added more than these new creations promise. They are ornamental shrubs with pleasing habit, abundant, glossy, attractive foliage of the rugosa type, and a wealth of bloom followed by large ornamental heps. The production of these rose shrubs is the tangible expression of a cherished horticultural ideal, and demonstrates dominance of mind over matter.

The awarding of the George Robert White Medal of Honor to Dr. Van Fleet is the placing of an honor well deserved. May he live to achieve a more complete fulfillment of his ideals!

The Birth Rate in Mixed Marriages

An increased birth rate in marriages between Jews and Lutheran Germans in Hamburg is described by R. E. May (Ztschft. f. Sexualwissenschaft, April, 1919). Taking several hundred marriages of each class, contracted in Hamburg in 1900, he found the following results in the birth records of 1901 and 1902: Both partners Jewish, 9.0 births per 100 marriages; both partners Lutherans, 11.7; husband Jewish, 14.0; wife Jewish, 19.6.

It is of course questionable whether the numbers involved are large enough to have any real significance in relation to fecundity. Professor May thinks they are and that the explanation is economic, rather than biological, the mixed marriages in his opinion representing cases where money was an important factor, and these households therefore being better able to afford children.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. XI, No. 3 March, 1920

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The Journal of Heredity is published monthly by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2.00, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912.

Date of issue of this number, May 6, 1920.

COTTON DISEASE IN CHINA

A branch of a Chinese cotton plant affected by the club-leaf (cyrtosis) disorder. In the lower part the internodes are of normal length and the leaves of normal size and shape, but change abruptly in the upper part to the short internodes and distorted leaves that characterize the disorder. Photograph natural size. (No. 81.) Nanking, China, Oct. 25, 1919. (Frontispiece.)

A DISORDER OF COTTON PLANTS IN CHINA: CLUB-LEAF OR CYRTOSIS

A Serious Limiting Factor of Production Not Hitherto Recognized, Resulting in Abnormal growth and Sterility

O. F. Cook

Bureau of Plant Industry, U.S. Department of Agriculture

WHY China does not produce more cotton is a question to be answered largely in terms of disease and insect injury. The total production undoubtedly could be increased greatly, and the quality improved, if selection and other precautions were applied, but the pests and diseases are not to be disregarded. In addition to direct damage by the pink boll-worm and other insects, there is a peculiar abnormality or disordered behavior of the plants, which undoubtedly is one of the principal limiting factors of cotton production in the central regions of the Yangtze Valley. Though not showing definitely diseased spots or other localized injuries that bacteria, fungi or insect parasites usually inflict, the plants are crippled, the leaves reduced in size, discolored and distorted, the petioles and internodes shortened, and the branching habits changed. Badly affected plants become somewhat club-shaped, with a dense "witches'-broom" growth of dwarf branches and small crumpled leaves at the top, which has suggested "club-leaf" as a name for the disorder.

OTHER NON-PARASITIC DISORDERS

The word *disorder* has been applied to other forms of abnormal behavior of cotton plants in the United States, such as the leaf-cut or tomosis, which also occurs in China and often is associated with severe cases of club-leaf. The effect of tomosis is to kill irregular areas of leaf-tissue, giving a ragged appearance that may be mistaken for insect injury. The damage begins with dead oil-glands and spreads to the neighboring cells, sometimes destroying large portions of young leaves, which may regenerate partly to form even rounded margins, but in very abnormal shapes (see Fig. 4).

Club-leaf shows a closer analogy, as well as more resemblance to the leaf-curl disorder caused by plant-lice. With both disorders the leaves are distorted, but in leaf-curl the base of the leaf is deeply crumpled, while in club-leaf the margins and lobes are more affected, rather than the base of the leaf. (Compare Fig. 3 with Fig. 4.) Leaf-curl affects the seedlings, is most prevalent in the spring months, and usually causes only slight and temporary injury, whereas the Chinese disorder does not come in the spring but is most injurious during hot weather, at the height of the fruiting season.

Though such disorders may not be directly transmitted they need to be studied from the standpoint of heredity. The different kinds of cotton show various reactions and degrees of susceptibility or immunity, which are constitutional in the plants, and undoubtedly are inherited. The cause of club-leaf was not determined, but leaf-hoppers were extremely abundant on cotton, soy beans, egg-plants and other crops that are planted together in China, and may be suspected of causing or transmitting the disorder.[1]

[1] A leaf-curl disease of cotton in East Africa has been ascribed to "cicaden." See Kraenzlin, G., 1911, Beitraege zur Kenntnis der Kraeusel-Krankheit der Baumwolle, Der Pflanzer, 7:327. For descriptions of leaf-cut and leaf-curl see Circular 120, Bureau of Plant Industry, U. S. Dept. Agriculture, issued April 5, 1913.

EXTREME FORM OF THE CLUB-LEAF DISORDER

Branch of a Chinese cotton plant showing very short internodes, many abnormal branches and closely crumpled leaves forming compact masses like the so-called "witches brooms." Photograph natural size, Nanking, China, Oct. 25, 1919. (Fig. 1.)

A LESS EXTREME FORM OF THE DISORDER

A tip of a Chinese cotton plant affected by the club-leaf in a less extreme form than that shown in the preceding illustration. This shows abnormal branching short internodes and distorted leaves but these symptoms are not developed to the greatest extent and the growth is less compact than in the worst cases. Photograph natural size, Nanking, China, Oct. 25, 1919. (Fig. 2.)

RELATION TO EXTERNAL CONDITIONS

The club-leaf disorder is manifested in many different degrees, depending upon external conditions and partly upon the variety. Though all of the plants become more or less abnormal in an affected area, individuals that stand side by side may show different degrees of deformity or reduction of the leaves, especially in the Chinese cotton and other unselected stocks. (See Figs. 1 and 2.) In severe cases all of the floral buds are aborted so that no more fruit can be set, and the crop is limited to the early bolls. Late-planted cotton suffers worse than early plantings, because there is less time to set a crop before the club-leaf begins. Plantings that fail to fruit early may remain completely sterile. With cooler weather in September or October, flowering and fruiting may be resumed, but the late bolls are not likely to open before frost. Hot weather in the spring is supposed to develop the disorder early in the season, and the injury is worse in some years than it was in 1919, according to native growers near Nanking.

Little injury is done by club-leaf in the coast districts around Shanghai, Hangchow and Nantungchow, but very severe injuries were found at Wusih, Nanking, Anking, Wuchang, Nanchang, and Yochow. In districts to the north of Nanking, as at Chuchow and Nanhsuchow, and north of Hankow, at Chengchow and Changteho, the club-leaf is generally present, but appears rather late in the season, so that the damage is not serious, and cotton is the chief crop in many districts. The country around Changteho, visible from the tomb of Yuan Shi Kai, appeared as an almost continuous cotton field. Around Peking and Tientsin club-leaf apparently ceases to be a factor of practical importance, only the last growth of the season being discolored or distorted.

The relative immunity of the more continuously humid rice country along the eastern coast may be explained by facts noted at Nanking University, where one corner of the experimental field was in lower ground and shaded from the morning sun by the wall of a compound and a row of trees. In this part of the field no symptoms of club-leaf disorder could be detected at the middle of August, though in other parts of the same field the disorder was strongly developed, and by the end of August it had appeared also on the later growth of the plants in the protected corner. In another protected and somewhat shaded planting at Nanchang, some of the very late growth of the Upland varieties seemed to be entirely normal, although somewhat older leaves of the same plants were discolored and distorted.

ABNORMALITY OF BRANCHING

A general symptom of club-leaf is the development of many branches from buds that in normal plants would remain dormant. Although vegetative branches usually are produced only from the lower joints of the main stalk, each leaf-axil contains a bud that may grow into a vegetative branch, following an injury or under conditions of luxuriance. In severe cases of club-leaf most of the axillary buds develop into branches, and even adventitious buds produce branches, sometimes four or five from the same node, a condition that might be described as abnormal proliferation or polyclady. The formation of extra branches goes farther with the Chinese cotton than with Upland varieties, and produces the densely club-like masses of foliage which suggested the name of the disease. (See Frontispiece and Figs. 1 and 2.) Upland varieties do not not form such dense masses of foliage, but retain a more open habit of growth as shown in Fig. 9.

SHORTENING OF INTERNODES AND PETIOLES

Another element of the changed appearance of the affected plants is the shortening of the joints of the stalks and branches, and the petioles of the

CHINESE COTTON LEAVES AFFECTED BY CLUB-LEAF

Club-leaf or cyrtosis of China somewhat resembles the plant-louse leaf-curl, but instead of the crumpling of the base of the leaf, the lobes are distorted and the margins rolled, with yellowing or reddening of tissue between the veins, shortening of petioles and internodes, abnormal branching and abortion of buds and bolls. Natural size. (Fig. 3.)

leaves. In this there is an analogy with the condition called "clustering" or "brachysm," which is a feature of some varieties of Upland cotton in the United States. In some varieties brachysm is definitely hereditary, while in others the shortening of the joints has relation to external conditions. But in brachysm only the joints of the fruiting branches are shortened, whereas the club-leaf disorder also affects the internodes of the main stalk and the vegetative branches. The shortening, like the abnormal branching, is carried farthest in the Chinese cotton, not so far in the Upland, and is still less apparent in the Sea Island and Egyptian types.

REDUCTION AND DISTORTION OF LEAVES

In severe cases of club-leaf the leaves are greatly reduced, often to less than half the normal size, and are twisted and crumpled over the entire surface, with a general arching or bending back of the midrib and principal veins, so that the lobes and margins of the leaf are turned under. In the native Chinese cotton these symptoms are carried somewhat further than in the foreign varieties, though Upland cotton also is severely affected, and sometimes the margins and lobes are rolled under more abruptly and regularly than with the Chinese cotton. (Compare Figs. 1 and 2 with Figs. 5 and 9.)

DISCOLORATION OF LEAVES

Though the discoloration differs in extent with varieties and conditions, an angular mottling of the web of the leaves is a regular feature of the club-leaf disorder, beginning along the margins and advancing into the thinner tissue between the lobes, though keeping away from the principal veins. At first the discoloration is only a paler and more yellowish-green, which continues in the Chinese cotton to the end of the season, but in Upland cotton a reddish tinge soon becomes appreciable and gradually becomes more pronounced. Late in the season, a deep red color renders the fields of Upland cotton strikingly different from the native Chinese cotton, even at a distance.

Among the Upland varieties grown at Nanking University and at the Wuchang Experiment Station, the Durango reacted most strongly in regard to discoloration and distortion of the leaves, and Columbia the least, but the Columbia seemed to be less mature than the other varieties, and maturity may be a factor in bringing the disorder into expression.

Connected, perhaps, with the more pronounced color reaction, is the fact that when affected plants of Upland cotton suffer from drought or other unfavorable conditions, the discolored portions of the leaves may dry out and die, the death of the tissue taking the same course as the discoloration, beginning at the margins, following back between the principal veins, and leaving a band of tissue alive along the veins.

The discoloration of the leaves, in connection with the other symptoms, suggests that the club-leaf may prove to be one of the so-called mosaic diseases, the causes of which are still obscure, though some of them, such as the sugar-beet disease of the United States and the sugar-cane disease of Hawaii, are supposed to be transmitted through the agency of insects. On the other hand, analogy with the leaf-curl caused by the plant-lice might account for club-leaf without supposing that a germ or parasitic organism is involved. Though the injuries are more serious than those of leaf-curl, there is a similar limitation to the growing tissues, with no appreciable effect upon the parts that have developed earlier in the season. The injury as a whole may be considered as a generalized gall-formation modifying the growth of the plant while the insects are active, but not affecting the tissues that are formed before or after. The discoloration symptom is lacking in the plant-louse disorder, but some galls are highly colored and others not. The club-leaf is not transmitted

LEAF-CUT OR TOMOSIS

Leaf-cut injuries are serious only in the spring when the plants are in the seedling stage. It begins at the oil glands and is caused by the death of angular areas of leaf-tissues, spreading to the neighboring leaf-tissues and resulting in very irregular mutilations, which, when very young leaves are affected, are sometimes healed by scars or regenerated by new growth. Natural size. (Fig. 4.)

A DURANGO COTTON PLANT

This plant was in a somewhat protected situation at Nanchang, China, but shows the effect of the club-leaf disorder, in a rather mild form, in its restricted growth, distorted and discolored leaves, and the fruit aborted. There is however little reduction in size of leaves or shortening of petioles. (21761.) (Fig. 5.)

through the seed, as may be inferred from the normal growth and fruiting of the plants early in the season, but if the disorder is caused by insects which live also on other plants, as seems not improbable, there would be danger of importation with ornamentals, nursery stock or bulbs.

GENERAL CONTRAST BETWEEN CHINESE AND UPLAND VARIETIES

Experiments with American varieties are being made in many places in China, in the hope that larger crops and better quality of fiber can be secured than from the native stock. The rapidly expanding textile industry of China needs more cotton, and efforts are now being made to increase production as rapidly as possible. The existence of such plantings made it possible in the season of 1919 to compare not only the normal behavior of the Chinese cotton and American varieties, but to observe the effects of the club-leaf disorder upon several kinds of cotton growing under a wide range of climatic and cultural conditions, as already noted.

The results of the comparison may be summarized by saying that the morphological reactions of the club-leaf disorder are most pronounced in the Chinese cotton, while in the American Upland varieties the physiological reactions are more striking. The Chinese cotton shows more pronounced changes in its habits of growth, while the U land cotton shows more discoloraion. Fruiting is suspended in both types when the club-leaf disorder is severe, though it was noted at Wuchang that the Trice cotton continued to produce bolls on the club-leaf growth, which in the neighboring Chinese cotton was entirely barren. Trice had a general advantage on account of earliness, though Lone Star and Acala appeared promising in some of the drier districts, and especially at Peking.

REACTIONS OF EGYPTIAN AND SEA ISLAND COTTONS

Several of the plantings included Egyptian and Sea Island cotton so that the club-leaf reactions could be compared. In general these types agree with the Chinese and contrast with the Upland in failing to develop a red discoloration of the leaves, but the rela-

DISEASED LEAVES OF EGYPTIAN COTTON

Plant-louse leaf-curl or hybosis, on Egyptian cotton, causing different degrees of distortion through shortening of the principal veins and crumpling or buckling of the web of the leaves but without mutilation or perforation, none of the leaf-tissue being killed. The effect of leaf-curl is to retard temporarily the growth of the plants, which recover completely when conditions become favorable for rapid growth in warm weather. Natural size. (Fig. 6.)

RUSSELL COTTON AT WUCHANG, CHINA

The club-leaf disorder has affected the plant in its later growth as shown at the top contrasting with the older normal leaves below. (Fig. 7.)

A LONE STAR COTTON PLANT

This plant, at Nanking, China, shows club-leaf in its later growth in contrast with the normal leaves of older growth. (Fig. 8.)

tions are reversed in respect to reduction and distortion, which are less than in the Upland cotton, and much le than in Chinese. Another difference is that the margins of affected Sea Island and Egyptian leaves usually curve upward, so that the lobes become more deeply channelled instead of being turned under. The Egyptian cotton at Nanking was nearly defoliated by the black-arm or angular leaf-spot disease, which also attacked the young involucral bracts, so that only a few bolls developed. This was in striking contrast with the Sea Island cotton in the next row, which remained vigorous and leafy and developed a good crop of bolls, though only a few were open at the end of October when frost was expected. The Upland cottons were less affected by angular leaf-spot than the Egyptian, though more than the Sea Island, while the Chinese cotton seemed not to be attacked.

DEVELOPMENT OF IMMUNITY BY SELECTION

A disorder that cripples the plants and distorts the leaves undoubtedly must increase the difficulty of selection and roguing, which are necessary to develop and maintain pure stocks of seed, but a possibility of developing immune varieties of the Chinese cotton is indicated by individual differences of reaction to the disorder that were noted in many cases. At Nanking a Chinese variety with red leaves showed much less reduction and distortion of foliage and grew to twice the size of the neighboring green-leaved plants. Another Chinese selection with very pale foliage and small white, unspotted flowers that did not open widely, showed a very extreme form of club-leaf injury. On the other hand a native grower east of Nanking considered a "purple-stem" strain of the narrow-leaved "chicken-foot" cotton more susceptible to the "wilt" than a "green-stem" form. At the Wuchang Experiment Station many plants of a slender, hairy, Indian variety did not appear to be affected at all by club-leaf, although the neighboring rows of Chinese cotton were very badly injured.

CLUB-LEAF IN DURANGO COTTON AT NANCHANG, CHINA

This shows that the general effect of the disorder is the same in Upland cotton as in the Chinese cotton, producing restricted growth, abnormal branching, shortened internodes and petioles, and rolling of the lobes, the last usually more pronounced than in the Chinese cotton. Natural size. (Fig. 9.)

POSSIBILITIES OF CONTROL

Though of a nature entirely different from boll-weevil injury, the club-leaf disorder may have a similarity in relation to control measures, in that early setting of a crop may offer the best possibility of avoiding injury, supposing that insects are responsible for the transmission of the disorder. To be rid of insects in China may be as impossible as to exterminate the boll-weevil in the United States. Upland cotton may have an advantage over the Chinese in the larger size of the bolls which may allow a larger crop to be set before the disease becomes injurious. Restricting the growth of the plants to insure early fruiting would be in order, but the usual Chinese methods do not produce large plants. An advantage in early fruiting seemed to have been gained in the vicinity of Nanking by planting cotton on high beds, which is supposed to warm the ground earlier in the spring.

Eugenics in Germany

A prize of 1,000 marks is offered by the German Medical Society for Sexual Science and Eugenics to the writer of the best thesis on the question, "Has man two kinds of spermatozoa?"

It is generally assumed by geneticists that the question is to be answered affirmatively. This assumption is based on results of experimental breeding, which are most satisfactorily interpreted by such a hypothesis. Cytologists, however, have not yet been able to offer satisfactory evidence from their microscopical studies to confirm the hypothesis.

The German society, which is now in its eighth year, publishes the Archiv für Frauenkunde und Eugenetik, which is now in its fifth volume.

At the meeting of January 16, 1920, Dr. Posner was elected president. The other officers chosen were: Dr. Franz, first vice-president; Dr. Iwan Bloch, second vice-president; Dr. Max Hirsch, first secretary; Dr. S. Placzek, second secretary; Dr. Otto Adler, treasurer; Dr. Blaschko, Dr. Grotjahn, Dr. H. Koerber and Dr. Stabel, directors.

The headquarters of the society are in Berlin W. 30, Motzstrasse 34.

Lock's Last Work

Recent Process in the Study of Variation, Heredity, and Evolution, by R. H. Lock, Sc. D. New (4th) ed., revised by L. Doncaster, Sc. D., F. R. S. Pp. 336, with glossary and illus. New York: E. P. Dutton & Co., 1916.

Dr. Lock published the first edition of his book in 1906. The second and third editions were his own revision; the fourth shows only slight changes, which are due to Dr. Doncaster. A sketch of Dr. Lock's life, by his wife, has been added to good advantage. The author gave up his life as a result of devotion to war service with the Board of Agriculture in England, in 1915, at the untimely age of 36. Most of his active years were spent at the Royal Botanic Gardens in Peradeniya, Ceylon, where he did useful work on rubber and rice particularly. The book is necessarily considerably out of date, yet it offers in many respects an excellent account for beginners in the study of organic evolution.—P. P.

HERITABLE CHARACTERS OF MAIZE

III. BRACHYTIC CULMS

J. H. Kempton

Bureau of Plant Industry, Washington, D. C.

THIS variation consists of a shortening of the internodes on the main culm and lateral branches without a corresponding reduction in number or in the number and size of other organs. It arose in 1917 in the second generation of the Chinese-Algerian hybrid designated Dh416[1]. This second generation was being grown from self-pollinated seeds. Approximately one-quarter of the plants were brachytic, the actual number being five brachytic and twenty-one normal. One of the five brachytic plants was self-pollinated, and the resulting progeny were all brachytic. The progeny of a normal sister plant were all of normal stature. Statistical data secured for several characters in both the normal and brachytic progenies are given in Table I. It will be seen from the table that the brachytic strain exceeds the normal in the diameter of the culm and the total number of nodes, while the size of the leaves is about the same. The upper ear is somewhat smaller in length, but this is apparently compensated for by the additional ears as the total ear length is approximately the same in the two strains.

Eleven hand-pollinated ears were obtained from the brachytic plants that were the result either of self-pollinations or crosses between sister plants. The progenies of these eleven ears without exception produced nothing but brachytic plants. These plants differed only superficially in their general dimensions from the parental brachytic progeny, their mean height being 8.8 decimeters. When crossed with plants of normal stature the first generation is as tall or taller than the normal parent, and in the second generation both normal and brachytic plants were secured in the familiar 3 to 1 Mendelain proportion.

Brachytic variations are found in many agricultural species, as, for example, the "bush" varieties of peas, beans, squashes and tomatoes, and are popularly known as dwarfs. Cook[2] has pointed out a distinction between dwarfs which have suffered a reduction in the size and number of many organs and those in which stature only is reduced. The designation brachytic has been suggested for the type where the internodes have failed to elongate.

Dwarfing involving brachysm and also true dwarfing or nanism is a variation which recurs in maize in widely divergent and wholly independent stocks. The instances, however, where brachysm alone is involved are not numerous. Hartley[3] apparently possessed a true breeding brachytic strain, although it would seem that the leaves were somewhat shorter and broader than those of normal plants and Gernert[4] describes a single brachytic plant.

[1]Kempton, J. H., "Inheritance of Spotted Aleurone Color in Hybrids of Chine-e Maize." *Genetics*, Vol. 4, May, 1919.

[2]Cook, O. F., "Brachysm—A Heredity Deformity of Cotton and Other Plants." *Journal of Research*, Vol. 3, No. 5, February 15, 1915.

[3]Hartley, C. P., "Improvement of Corn by Seed Selection." Year-book, U. S. Dept. Agric., 1912.

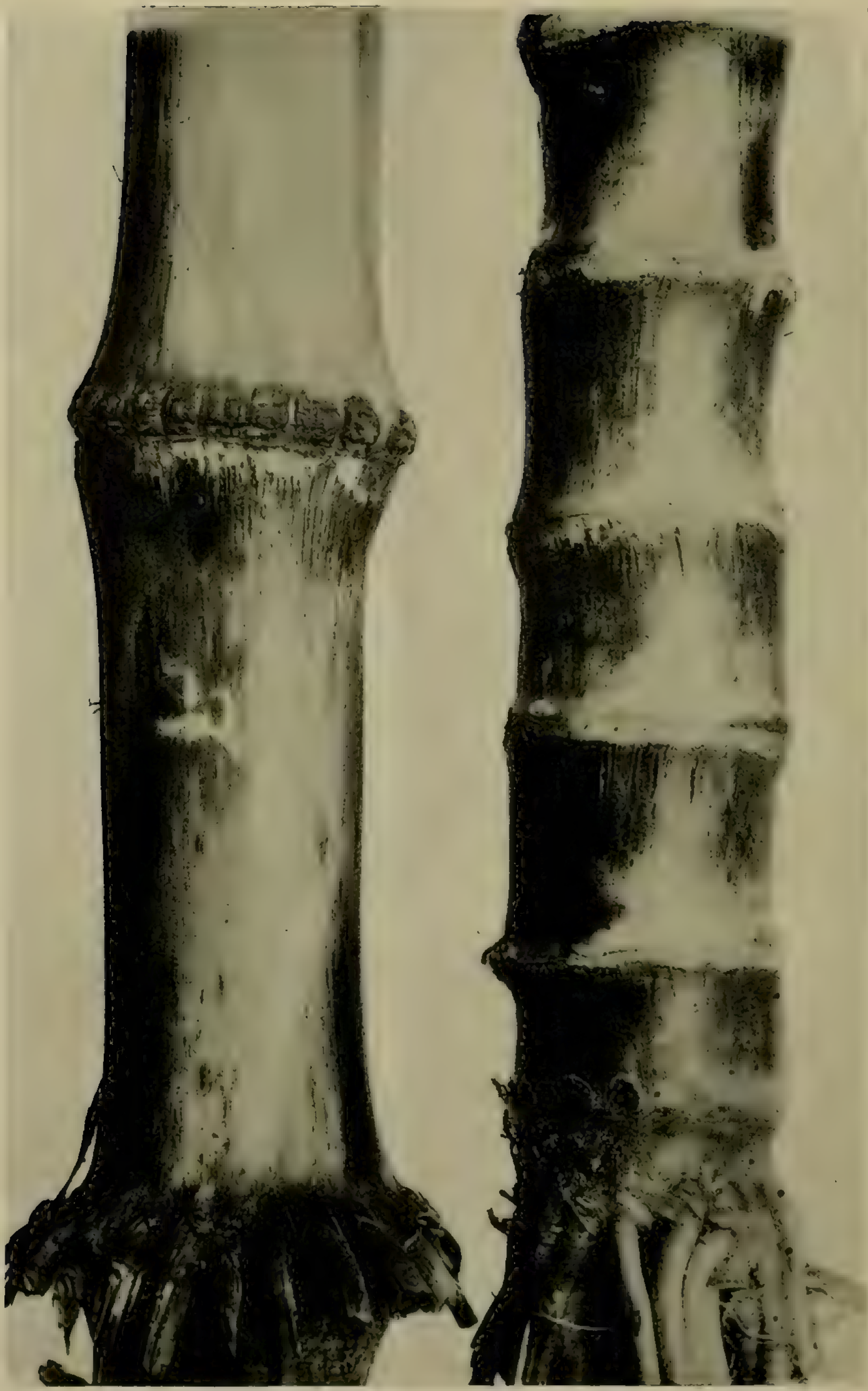
[4]Gernert, W. B., "The Analysis of Characters in Corn and their Behavior in Transmission." Champaign, Ill., 1912.

BRACHYTIC AND NORMAL MAIZE PLANTS

A brachytic plant is distinguished from an ordinary dwarf in that it is reduced in stature only, while in the dwarf all of the organs have been diminished in size. A brachytic maize plant is shown at the left compared to a normal plant at the right. The brachytic plant arose in the second generation of a hybrid and when self pollinated bred true. It equalled the tall plant in leaf area and produced two more nodes. (Fig. 10.)

BRACHYTIC AND NORMAL MAIZE PLANTS WITH LEAVES REMOVED

Another view of the same plants shown in Fig. 10. The leaves have been removed to show the character of the internodes. Brachytic plants are unusually well adapted for harvesting with hogs. (Fig. 11.)



NORMAL AND BRACHYTIC MAIZE STALKS

Showing the internodes just above the surface of the ground. Note that while in the brachytic stalk six internodes have been "compressed" into the space normally occupied by one and a half, the thickness of the stalk has not been diminished at all in the process. With short internodes, more nodes produce roots below the surface of the ground. Photograph natural size. (Fig. 12.)

TABLE I.—*Measurements of Plants of Two Sister Progenies One of Which Was Brachytic, the Other Normal in Stature.*

	Brachytic	Normal
Height of plant in decimeters	8.66±0.10	14.40±0.24
Number of leaves above the ear	3.20±0.08	3.37±0.09
Total number of leaves	22.90±0.19	20.80±0.27
Husk leaves	0.06±0.02	0.58±0.13
Number of branches in the tassel	15.30±0.64	25.90±1.01
Length of the upper ear in cm	14.20±0.27	16.40±0.23
Total ear length cm	27.60±0.98	28.10±0.71
Number of rows on upper ear	16.30±0.26	21.20±0.30
Diameter of Culm in 16th inches	20.50±0.35	12.40±0.21
Length of fourth leaf	62.60±6.20	64.40±8.90
Width of fourth leaf	9.20±1.40	12.30±1.50

In our experiments two other brachytic variations have appeared. One of these arose in a hybrid having as one parent the Chinese wax-variety, while the other arose in the progeny of the hairy Esperanza variety.[5] Both of these variations were similar in appearance to the brachytic type just discussed. In heredity, however, they were very dissimilar.

The brachytic Esperanza plant was not self-pollinated but was crossed with a normal plant of the Chinese waxy variety. The first generation plants exceeded in height the normal Esperanza plants and in the second generation showed only the normal frequency distributions with respect to height.

The other brachytic variation, also contrary to the usual behavior, did not breed true when self-pollinated, but some brachytic plants were again secured.

The strain breeding true for brachytic culms is of interest in that it is associated with few or none of the undesirable features which commonly accompany such variations and may therefore be of some agricultural value. This strain would also seem to provide one more true breeding simple Mendelian character with which to test the linear arrangement of factors. A stock of seed has been obtained, and small samples will be furnished to those who may wish to experiment further with this variation.

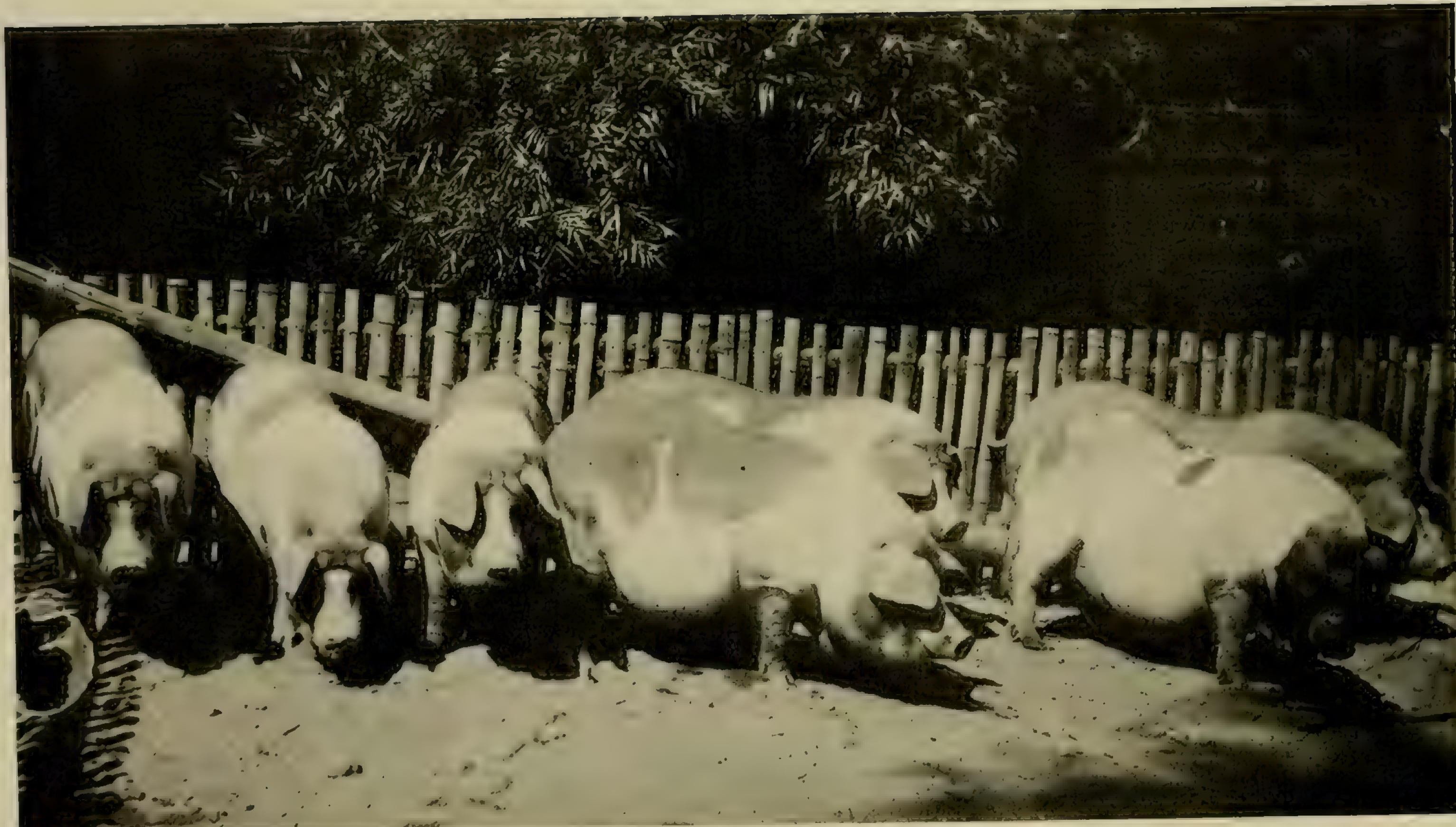
MENDELISM, by Reginald Crundell Punnett, F. R. S. Pp. 219. Illus. Fifth ed. London: Macmillan & Co., Ltd., 1919.

For nearly fifteen years Punnett's Mendelism has enjoyed a well-deserved popularity, because of its simple and readable account of the elements of genetics. It has been translated into German, Swedish, Russian and Japanese; and it has now been issued with additions calculated to bring it up to date, the last English edition having been put out in 1912.

By American standards, however, it is far from up to date, for Professor Punnett is not willing to accept the conclusions which American geneticists draw from the work that has been done here during the last decade. He clings to a terminology that in the United States is confusing because obsolete, and to conceptions that in the United States were long ago discarded.

English conservatism is doubtless useful in science; but in this case it has prevented a well-written book from being of much use to American students.—P. P.

[5]Collins, G. N., "Correlated Characters in Maize Breeding." *Journal Agric. Research.* Vol. vi, No. 12, June 19, 1916.



TYPICAL CHINESE HOGS RAISED AT THE CANTON CHRISTIAN COLLEGE

These represent a fairly good type of the lard hog common in most parts of China particularly in the south. Low backs and large bellies are characteristic of this breed, and among its chief objections. The hogs are, however, free from tuberculosis. "It is this hog that was largely used in the early development of European breeds." (Fig. 13.)

SWINE, SHEEP AND GOATS IN THE ORIENT

Important Factors in the Animal Industries of China Which Show Need for the Application of Modern Principles of Animal Breeding—Average Village Farmer Knows Little About Proper Feeding and Selection of Best Types

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IN CHINA the swine industry is next in importance to that of raising poultry. It is difficult to ascertain the number of pigs raised each year in that country, and all estimates are little more than rough guesses. Prof. King, in his interesting book, "Farmers of Forty Centuries," estimates the number of pigs in Shantung at 25,000,000, a number equal to one for each inhabitant in that province. A conservative estimate of pigs raised annually in China would be 100,000,000. At the low price of $12 (Mex.)[1] each, which is the amount received for the average pig sold on the market, the annual pig crop would have a value of $1,200,000,000 (Mex.). During the years from 1915 to 1917 the average annual exports of swine exceeded the imports to the amount of 2,000,000 taels.[2] Most of the hogs exported were sent to Kongkong and to Russia. A large number of those sent to Hongkong are butchered and converted into lard, which is then shipped to Liverpool.

The exportation of bristles, a by-product of the swine industry, is of considerable importance, the amount of this product from Shantung province alone amounting to about 500,000 pounds a year. The prices paid by exporters for cleaned, sorted and dried bristles varies from $20 to $220 (Mex.) for 100 pounds.

DESCRIPTION OF CHINESE LARD HOGS

Hogs in different parts of China vary considerably in size and type. The common lard hog is found in most places of the South. They range in color from nearly white to black, or black with white points. In some localities the pigs' ears are large and pendulent, while in others they are small and erect Then again, these two types may be found in the same community.

A peculiar characteristic of the lard hogs of China is their straight tails. They do not have the "kink" which is characteristic of the tails in modern breeds. It is this hog that was largely used in the early development of European breeds. The meat is of good quality and cures fairly well. As a rule the hogs are fine-boned and smooth; those with wrinkled sides are seldom seen. They are slow in maturing. Twelve hogs at the Canton Christian College in 1917 made an average gain, at six months of age, of about 0.65 of a pound a day on full feed. When one year old they usually weigh from 200 to 250 pounds. The average dressing per cent of thirty-two hogs butchered at the College in 1917 and 1918 was 72.5%. The chief objection to this hog is its low back, scant hams, large belly, low dressing percentage, and weak pasterns, which easily break down in the animal that is being fattened.

CHINESE METHODS OF RAISING PIGS

Most farmers who raise hogs keep from one to five or six brood sows. The litters are large. A sow is supposed to be able to nurse at least ten pigs, which seems to be the average

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[1]$1.40 Mex. is equal to about $1 U. S. currency.
[2]With the present rate of exchange, one tael is equal to about $1 U. S. currency.

number in the Canton region, although as many as fifteen are frequently seen with one sow.

During the day the sow and pigs roam at will in the narrow, stone streets of the villages, picking up what edible garbage they can find. Sometimes, however, the sow is muzzled when thus turned out with her family of pigs.

Pigs are usually castrated and spayed when they are six to ten weeks old and still sucking, although animals weighing as much as 100 pounds are sometimes thus operated on. The Chinese consider it just as necessary to spay gilts as to castrate boars. Meat from unspayed gilts is somewhat coarser than that from spayed animals, and better growth is also obtained by spaying.

Both operations are considered arts and practiced only by a few experts. Spaying is never attempted by the farmer himself, and castration only when the services of an expert cannot be secured. A professional usually has an apprentice along to assist him. After a time the apprentice performs the operations himself and becomes an expert provided he can work rapidly enough. The methods used are the same as those in western countries. Spaying, however, is somewhat different.

No disinfectants are used, nor is the operator particular about the pig, or his own hands being clean. No doubt many of the few losses which do occur are due to this lack of sanitary precaution on the part of the operator, and because of the fact that feed is not reduced either before or after the operation. In the fall of 1918 the service of a local hog "veterinarian"—if he should be referred to by such an honorable title—was secured by the College, and four gilts weighing about forty pounds each were spayed. The operator was allowed to use his own methods. No disinfectants were used, nor was the amount of feed reduced, either before or after the operation. The operations were successful in every case. Very little discomfort was shown by the pigs after the operation, and they did not get "off feed."

HOG FEEDING PLANTS IN CONNECTION WITH DISTILLERIES

Hog feeding plants, feeding from 100 to 300 hogs at a time, are usually found in connection with rice wine distilleries. In Honam, south of Canton, there is a representative plant of this kind. This is a rice wine distillery, with a hog feeding plant run in connection. The writer last visited the plant on November 2, 1918. At that time about 200 hogs were being fed, which was the full capacity of the plant. No brood sows are kept, but pigs weighing about 50 catties[3] are purchased from the village farmers. Brewer's grains from the distillery form the largest part of the ration fed, although some rice chop and wheat bran is also fed. About 600 catties of dry feed are required in this plant to make 100 catties of gain in weight. The hogs are fed for from 200 to 250 days, and, when sold, weigh from 140 to 200 catties. The size of the hogs when sold and the length of the feeding period depend on the individual hogs and on the market prices and demands.

The price paid for rice chop varies from \$3.00 to \$4.00 (local silver [4]) for 100 catties. Brewer's grains sell for 40 cents for 100 catties. Manure from the plant sells for 30 cents for 100 catties. The price received for the hogs on the market is variable. The average price during the years from 1916 to 1918 was \$20.00 (local silver) for 100 catties, varying from \$16.00 to \$24.00. The prices paid for market hogs depend on the size, condition, and the demand at different seasons. Hogs weighing about 150 catties usually bring the best prices; and the prices are usually higher during the winter than at other times of the year. Stags and sows, even when fat and in good condition sell for about three-fourths the

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[3] A catty, the common unit of weight in China, is equal to 1 1/3 pounds avoirdupois.
[4] During past two years about \$1.30 local silver has equalled \$1 U. S. currency.

A TYPICAL CHINESE LARD HOG

Chinese hogs vary a great deal in type according to the part of the country from which they come. The straight tail is one of their peculiar characteristics. The usual weight when a year old is from 200 to 250 pounds. (Fig. 14.)

price of good barrows and spayed gilts. Unspayed gilts also sell at a cut price.

The hogs in the plant described above are kept in a brick building across the street from the brewery. They are all kept in one room, about 30 feet wide and 80 feet long. Pens are arranged along the sides of the room with an alley about 6 feet wide in the center. These pens are 12 feet square, and each contains from ten to fourteen hogs. A pen of hogs usually represents one litter. The floor of the entire room is paved with brick tile, sloping from the pens to the alley-way, on either side of which is a gutter. The floor is kept very clean, being washed twice a day, and the pigs themselves get washed in the process of washing out the pens. The solid manure is cleaned from the pens before each washing and stored in a brick and concrete tank at the end of the room where it remains until it is removed by buyers.

THE FEED OF VILLAGE PIGS

Three times a day the village sow and pigs are fed a mixture of a cheap grade of rice chop and rice bran, and sometimes wheat bran, about the proportion of half and half. Wheat bran is considered a better feed than rice bran, but it is usually higher in price. In the vicinity of breweries, brewer's grain, a by-product of the rice wine industry, forms a part of the ration. Vegetables and green cut grasses are fed. The rice is always fed cooked. Other kinds of feed are uncooked. In regions where corn is as available and cheap as rice, it furnishes the main fattening part of the ration. At night the hogs are kept

A CHINESE HOG ON ITS WAY TO MARKET (Fig. 15.)

in a room, which is usually next to the owner's living quarters. The floor is usually paved with tile or brick. Sometimes a corner of the living rooms is fenced off for the sow and her family. The floor is usually kept very clean.

From the time they begin to eat, the pigs are given all their feed in the form of a very wet swill. Three times a day they are allowed to drink all they can hold of this feed, which permanently enlarges the belly and tends to pull the animals down in the back. By proper feeding and intelligent selection of breeding stock of the best type, these two undesirable characteristics, sway-back and pot-belly, could be remedied.

The average hog in China is raised on as clean food as the hog in America is. It is not a scavenger like the native hogs in India and the Philippine Islands, and it is fairly free from diseases, except for hog cholera, which is very prevalent.

FRESH MEAT AND "WATERED MEAT"

About 1,000 hogs are killed every day in the small Canton butcher shops. The hogs are butchered early in the morning in small slaughter houses and delivered immediately to the retail shops. In some shops the hogs are butchered in the rear of the retail store, which opens directly on the street.

Dishonest butchers who do not mind putting their reputation at stake have an interesting method of injecting water into the hogs just after they have been killed and bled. The water is forced in through the vena cava. The carcass of a hog may be increased in weight by several pounds by thus "watering" the meat. It is difficult to detect such meat until it is eaten. It has a poor flavor compared with normal meat and will not cure well. This practice is so general that it is difficult to secure pork in Canton which has not been thus treated.

HOG CHOLERA IN CHINA

Among the diseases of swine, hog cholera, known in England as swine plague, and common in all parts of the world where pigs are raised, is prevalent in all parts of China, where it is known

IN A CHINESE VILLAGE STREET

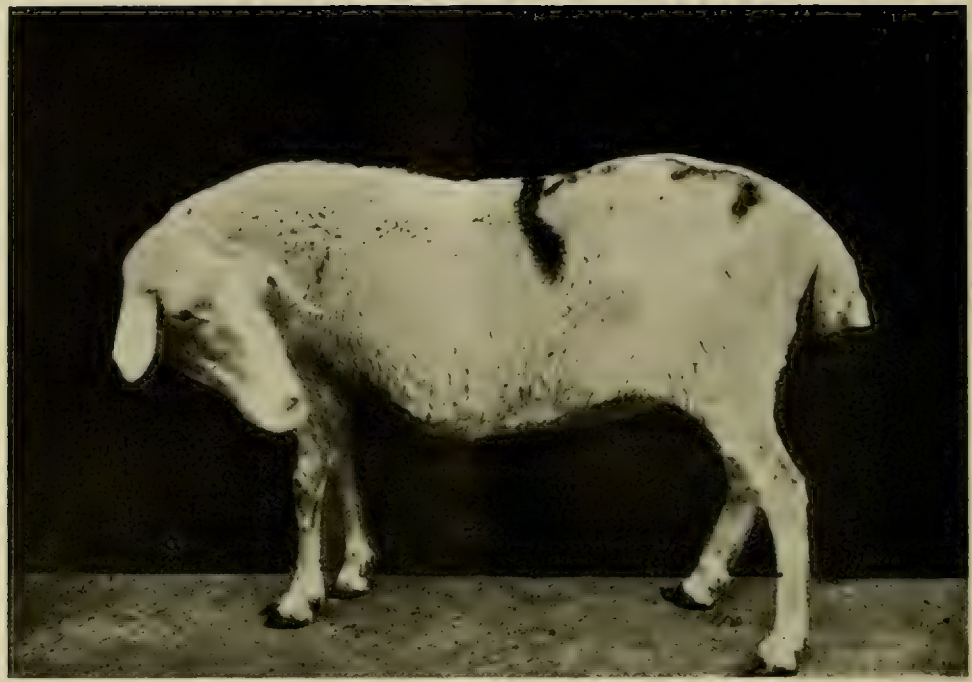
"During the day the sow and pigs roam at will in the narrow stone streets of the villages picking up what edible garbage they can find. Sometimes, however, the sow is muzzled when thus turned out with her family of pigs." (Fig. 16.)

as Chue Waan. During the months of March, April, and May, it is most prevalent in the south of China. In the delta region of Canton about 40% of the spring pigs die each year or are marketed because of this widespread disease. The farmers recognize the disease by the characteristic deep red or reddish-purple spots on the abdomen, gummy eyes, spotted kidneys, and inflamed intestines, which are the common symptoms in this region. It is usually accompanied by a high fever. The Chinese have learned by experience that there is no cure for the disease, and know that it is very infectious. It usually proves fatal. Experienced veterinarians, and laboratories for the production of vaccine for the prevention of the disease, are badly needed.

Keeping brood sows to an extreme old age, or until they become sterile, is probably the salvation of the hog industry in China. Such sows have either had mild attacks of cholera when young and have become immune or are highly resistant to the disease, for, according to village farmers, very seldom does a sow more than 3 years old get the disease. Further study is necessary to determine the extent of this natural or acquired immunity. Evidently it is quite common, as none of the old sows observed in the villages surrounding Canton, where cholera rages nearly every year, have any of the appearances common to hogs that have recovered from a severe case of cholera.

TUBERCULOSIS AND PARASITES

Tuberculosis, a disease quite common among hogs and other livestock in America and Europe, gives very little trouble to native livestock of southern China. According to Dr. A. Gibson, who has been the Colonial Veterinarian of Hongkong for thirteen years, and who has examined the carcasses of thousands of hogs in the government slaughter house, tuberculosis in Chinese hogs is very rare; in cases that have



A FAT-TAILED SHEEP

This breed of sheep is common in all parts of northern China. The large tail characteristic of this variety contains a very considerable amount of fat and thus the breed has been called the fat-tailed sheep. In arid regions, when food is not plentiful enough, the fat in the tail is drawn on to supply nourishment for the rest of the body. (Fig. 17.)

been observed, they are invariably the animals that have been closely housed with the European hogs. This freedom from disease is indeed fortunate, for tuberculosis is one of the few diseases in animals which we dread, not only because of the effect of the disease on the animal itself, but because of the possibility of its being transmitted to man.

Fewer internal parasites are common in the native hogs than one would expect. A number of tapeworm cysts have been found in nearly every hog we have butchered at the college during the past three years, but, according to Prof. Howard of the Biology Department of the Canton Christian College, they are not the cysts of the tapeworm that is found in man. Dr. Gibson also reports he has not yet found the cyst of the human tapeworm in the native hog. Here again we are fortunate, and great care should be taken not to introduce this parasite from other regions.

Kidney worms and liver flukes, usually common in hogs, have not been found in the hogs of southern China. A skin disease in the form of a pox is very common. It, however, does not seem to be a serious disease. With the exception of cholera, the native hog in South China is, as a whole, a fairly healthy animal.

YUNNAN HOGS

In the hilly and wooded regions of the western provinces of Yunnan and Szechwan the type of hog chiefly raised is the bacon hog. This type produces a good meat for curing. According to Dr. Gibson, attempts so far to raise this hog in Hongkong have shown that it cannot compete with the common lard hog in the efficiency of utilizing feed. However, if allowed to

NATIVE GOATS IN SOUTH CHINA

Goats are raised in China for meat only. Swiss and Indian breeds of milk goats have been introduced into some of the provinces but not to any great extent. (Fig. 18.)

graze, as in Yunnan and Szechwan, it might make a better showing in southern China. The Yunnan ham, found in the Canton and Hongkong shops, and in other parts of China, and exported to the Philippine Islands, is well known in all parts of China because of its excellent qualities.

BREEDING OF SWINE

One has only to study the breeding stock in the villages about Canton to realize that the average village farmer knows very little about the breeding of animals. Some of the sows are fairly good, but the boars are usually very inferior. About the only good thing that can be said about the boars is that they are sure breeders, and very prolific. The prevalent idea is that any animal is good enough for breeding. Often the poorest male is reserved for stud purposes. From the time he is weaned he is kept tied with a sort of rope harness fitted around his neck and chest. He is lead about from village to village by his owner. On Honam Island, across the river from Canton, one boar is used for from 200 to 300 sows. The boars are always undersized, thin, gaunt and weak looking, but they are unusually gentle and do not have the vicious temperament so commonly seen in boars of improved modern breeds.

MODERN BREEDS OF HOGS IN CHINA

Modern breeds of hogs have not yet been introduced into China to any extent. The Hongkong Dairy Farm has done considerable experimenting with different breeds, and now uses the Midyorkshire hog of England almost exclusively, both pure and in crossing with the native hogs. The farmer usually

has on hand from 600 to 900 of this breed of hogs. The Berkshire hog, an English breed whose early development was brought about largely through the use of Chinese and Siamese blooded stock, may prove a success in this climate, as it has done in the Philippine Islands, where most breeds up to the present have been little more than failures, due largely to the readiness with which they succumb to the kidney worm. The Berkshire hogs seem to be able to resist the kidney worm better than any other of the modern breeds. However, as the kidney worm does not seem to be common in China, other breeds may also prove a success.

CHINESE SHEEP AND GOATS

Sheep.—Sheep of the fat-tailed, hornless variety which is supposed to have originated in Afghanistan, are found in nearly all parts of northern China, especially in the provinces of Shantung and Chihli. These sheep are so named because of their large tail which carries a large amount of fat. The tail is usually 8 to 10 inches long, 6 inches wide, and 3 inches thick. It serves as a store for food, and in seasons of drought and scarcity of feed the fat contained in the tail is used up in the body. It is said that after a few generations of rich feeding in lands where nourishing feed is more available, the size of the tail gradually diminishes, approaching the size common to other breeds of sheep.

The fat-tailed sheep produce fair wool, though it is inferior in both quantity and quality when compared with that of modern breeds of wool sheep. According to the Japanese investigators in 1916 the annual amount of wool produced in Shantung amounts to 39,000,000 pounds. Most of the wool produced in this region is sold to Japan at about 20 taels a picul[5], the annual sales amounting to 6,000,000 taels. The Japanese use most of the wool for making clothing for the soldiers. It is estimated that each sheep will yield in one year with two shearings four catties of wool. At this rate the total number of sheep in Shantung must be at least 7,500,000. The customs authorities give a value of 5 taels a head for sheep. The mature sheep alone in Shantung at this rate have an annual value of 35,000,000 taels.

Goats.—The native black and white goat of China is raised for meat only. In Shantung a Swiss breed of milk goats, known as the Saanen goat, has been introduced by the Germans, and seems to thrive well in that region. Indians have brought with them to Hongkong an Indian breed of milk goat which is doing well in that region.

SHEEP AND GOATS IN SOUTHERN CHINA

Canton imports from the north 8,000 fat-tail sheep, and 4,000 meat goats for slaughter each year, or at the rate of thirty a day. Hongkong also imports in large numbers from the north. Goats of the meat breed are raised to a small extent in South China, but no sheep are raised in the southern provinces. Dr. Adam Gibson, reports that attempts to raise sheep in the south have failed because of the readiness with which they become infested with the liver fluke. Goats butchered at the college in 1917 by the writer were found to be badly infested with this parasite, but evidently the affect on goats is not as serious as with sheep.

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[5]A picul equals 133 1/3 pounds.

INBREEDING AND OUTBREEDING

Review of the Evidence by East and Jones Shows that the Influence of these Factors Depends Wholly on the Inherited Traits Present

Paul Popenoe

FEW phases of genetics have in the past been surrounded with more superstition and ignorance than inbreeding, and few phases have been more thoroughly cleared up by experimental breeding during recent years. A comprehensive book on the subject is therefore timely, and Dr. East and Dr. Jones are well qualified to assemble and weigh the evidence on the subject, for they themselves have provided some of the best of it.[1]

The importance of an understanding of inbreeding and outbreeding is by no means limited to the plant-breeders and animal husbandmen. The authors suggest three questions which will show what important sociological bearings exist:

1. Do marriages between near relatives, wholly by reason of their consanguinity, regardless of the inheritance received, affect the offspring adversely?

2. Are consanguineous marriages harmful through the operation of the laws of heredity?

3. Are hereditary differences in the human race transmitted in such a manner as to make matings between markedly different peoples desirable or undesirable, either from the standpoint of the civic worth of the individual, or of the stamina of the population as a whole?

After discussing briefly the question of reproduction and the mechanism of heredity, the authors turn to a consideration of the experiments on which modern ideas of inbreeding and outbreeding are based. These experiments are well known to readers of the Journal of Heredity and need not be rehearsed. Some of them have lasted for nearly fifteen years of the closest possible inbreeding, the most valuable data being derived from maize, rats and guinea-pigs.

IS INBREEDING INJURIOUS?

Few students will differ from the authors when they conclude that "inbreeding has but one demonstrable effect on organisms subjected to its action—the isolation of homozygous types. The diversity of the resulting types depends directly upon the number of heterozygous hereditary factors present in the individuals with which the process is begun; it is likely, therefore, to vary directly with the amount of cross-breeding experienced by their immediate ancestors. The rapidity of the isolation of homozygous types is a function of the intensity of the inbreeding."

"Are, then, the immediate results of inbreeding sometimes injurious? In naturally cross-fertilized organisms they most emphatically are—nay, more, even disastrous—when we recall the reduction to over one-half or one-third in production in grain and a corresponding decrease in size of plant and rate of growth in maize. But maize is probably an extreme case. With other organisms the results are not so bad, and in some cases, especially when selection has been made, no evil effects

[1] "Inbreeding and Outbreeding: Their genetic and sociological significance," by Edward M. East, Ph.D., Harvard University, Bussey Institution, and Donald F. Jones, D.Sc., Connecticut Agricultural Experimental Station. Pp. 285, with 46 illus. Monographs on Experimental Biology. J. B. Lippincott Co., Philadelphia and London, 1919. Price, $2.50 net.

are apparent. In fact, there may be an actual improvement. But the truth is, we did not set out to answer that question. It had already received a correct answer. *What we undertook to inquire was whether inbreeding is injurious merely by reason of the consanguinity.* We answer, *"No!"* The only injury proceeding from inbreeding comes from the inheritance received. The constitution of the individuals resulting from a process of inbreeding depends upon the chance allotment of characters pre-existing in the stock before inbreeding was commenced. If undesirable characters are shown after inbreeding, it is only because they already existed in the stock and were able to persist for generations under the protection of more favorable characters which dominated them and kept them from sight. The powerful hand of natural selection was thus stayed until inbreeding tore aside the mask and the unfavorable characters were shown up in all their weakness, to stand or fall on their own merits.

INBREEDING AS A MEANS OF IMPROVEMENT

"If evil is brought to light, inbreeding is no more to be blamed than the detective who unearths a crime. Instead of being condemned it should be commended. After continued inbreeding a crossbred stock has been purified and rid of abnormalities, monstrosities, and serious weaknesses of all kinds. Only those characters can remain which either are favorable or at least are not definitely harmful to the organism. Those characters which have survived this 'day of judgment' can now be estimated according to their true worth. As we shall see later, vigor can be restored immediately by crossing. Not only is the full vigor of the original stock restored, but it may even be increased, due to the elimination of many unfavorable characters. If this increased vigor can be utilized in the first generation, or if it can be fixed so that it is not lost in succeeding generations, then inbreeding is not only not injurious, but is highly beneficial. As an actual means of plant and animal improvement, therefore, it should be given its rightful valuation."

Heterosis or hybrid vigor has already been alluded to. What is its explanation? Evidently, since it is the reverse of inbreeding, it merely means a stimulation due to the presence and complementary action of dominant factors.

After a brief discussion of sterility, and of the rôle of inbreeding and outbreeding in evolution and in breed-improvement, the authors pass on to man—a subject with which they show less familiarity, although their general conclusions are for the most part sounder than their illustrations.

After describing some of the strains of degenerates which have practiced inbreeding, and also mentioning the Athenians of the Golden Age, whose superiority they believe to have been largely due to inbreeding, they conclude:

"Owing to the existence of serious recessive traits there is objection to indiscriminate, irrational, intensive inbreeding in man; yet inbreeding is the surest means of establishing families which as a whole are of high value to the community. On the other hand, owing to the complex nature of the mental traits of the highest type, the brightest examples of inherent mental ability have come and will come from chance mating in the general population, the common people so called, because of the variability there existent." The latter proposition is not supported by adequate evidence, and it is doubtful whether the authors could support it if they tried.

POPULATION AND FOOD SUPPLY FORCING RACIAL COMBINATIONS

Turning to cross-breeding, the authors discuss "the intermingling of races and national stamina." They look forward to a continual increase in the process of racial amalgamation.

"The truth is," they declare, "that the world is approaching a population limit

faster even than Malthus supposed, and the result of applying new methods to field culture is merely to exploit the natural fertility of the soil at a higher rate. The supposed increase in the amount of food is illusory. In the United States, naturally the richest country on the globe, *the per capita production* of all the important meat animals and some of the great agricultural crops *is decreasing*.

"At present the situation is this: China, having reached the limit of her food supply, and having little or no foreign trade, has become stationary in population. Large portions of Europe and the country of Japan have reached the limit of sustenance within themselves, but are increasing at a rate of from 10 to 15 per 1,000 annually because their commerce is such as to permit importation to supply the deficit. Australia and Asia are increasing at a rate which neither their agriculture nor their commerce can sustain. The Americas and Africa are left as the great centers of colonization. Each will support a large additional number of people, but when they have reached their limit—and that limit will come within a very few centuries, three at most—each country, or at least each continent, must support its own population.

"The world faces two types of racial combination: one in which the races are so far apart as to make hybridization a real breaking down of the inherent characteristics of each; the other, where fewer differences present only the possibility of a somewhat greater variability as a desirable basis for selection. Roughly, the former is the color-line problem; the latter is that of the White Melting Pot, faced particularly by Europe, North America and Australia."

The authors conclude that the first kind of crossing is undesirable, even if the two races are both superior, because it would tend "to break apart those compatible physical and mental qualities which have established a smoothly operating whole in each race by hundreds of generations of natural selection." It is still more objectionable in a cross between two races one of which (as the Negro) is genetically of inferior capacity to the other (as the white).

Their "second thesis is somewhat paradoxical. It asserts that the foundation stocks of races which have impressed civilization most deeply have been produced by intermingling peoples who through one cause or another became genetically *somewhat* unlike." This thesis is supported by some very weak evidence, often little more than supposition. Indeed, many of the anthropological data presented should be backed up by proof; what is the evidence, for example, which indicates that the mulatto shows "extraordinary physical vigor?" And the authors are likely to get a challenge from some son of Erin, for they state that the true Irish "are in the main descended from two savage tribes, the Iberian and the Turanian, both probably Mongolian admixtures," and that their descendents "have hardly a single individual meriting a rank among the great names of history, or a contribution to literature, art, or science of first magnitude."

A MORE CAREFUL SELECTION OF IMMIGRANTS IS NECESSARY

"To produce greatness," the authors conclude, "a nation must have some wretchedness, for such is the law of Mendelian recombination: but the nation that produces wretchedness is not necessarily in the way of producing greatness. There must be racial mixture to induce variability, but these racial crosses must not be too wide, else the chances are too few and the time required is too great for the proper recombinations making for inherent capacity to occur. Further, there must be periods of more or less inbreeding following racial mixtures if there is to be any high probability of isolating desirable extremes. A third essential in the production of racial stamina is that

the ingredients in the melting pot be sound at the beginning, for one does not improve the amalgam by putting in dross."

They therefore hold that the indiscriminate admission of alien immigrants to the United States should be slowed up.

Eugenics in Scandinavia

"We are going to start this month a weekly or monthly review under the title *Den Nordiske Race*. The review will be printed in Kjobenhavn and edited from Winderen Laboratorium in Kristiania. The time has come to organize a work for the Nordic race, especially based on applied race-biologie or race-hygiene. Some of the best scientists in our Scandinavian countries are my fellow-workers. The review will be printed in the Scandinavian languages, but will contain short translations of the original articles into English or German, so that the Scandinavian workers will be able to come in contact with fellow-workers all the world over."

This is a portion of a letter written by Dr. Jon Alfred Mjoen of the Winderen Laboratory, Christiana, Norway, to the chairman of the Eugenics Research Committee of the American Genetic Association, who replied as follows:

"The idea of founding a journal concerned with the Nordic race should meet with earnest and widespread encouragement. It is particularly fitting that such a journal should emanate from Scandinavia, the original home of this dominant race, which many waves of migration have carried forth to all parts of the world.

"Doubtless other races than the Nordic possess many desirable traits of emotion and imagination, but the far-flung Northern race is the only one that excels in practical administration and devotion to scientific discovery. The Normans were great administrators. They came from Scandinavia. Probably the ruling and noble classes among the Greeks, northern Italians, Spanish and Portuguese came from the north, though somewhat mixed with southern blood. For a thousand years the royal families of Europe have exerted great influence and have acted and reacted on its history in an important way. The genealogies of these people can be traced through long generations, and these lineages lead almost without exception directly back to the shores of the Baltic.

"As regards science, both pure and applied, the history of science proves that, barring the work of the Greeks, original advances have been made almost entirely by peoples of Nordic origin. England, Scotland, France, Germany, Norway, Sweden, Denmark—all exceed their share in the production of men of scientific eminence. Russia, Ireland, Austria, Spain, Portugal, the Balkan countries and all Eastern lands fall short of non-Nordic countries. Switzerland alone exceeds its quota.

"If one is interested in the development of the world in practical administration, or the advancement of pure or applied science, one should feel not only a devotion towards the Great Race, on account of its past achievements, but should never cease to realize the high obligation towards posterity, and the need for preserving and forwarding its traditions, by understanding its past and expanding its future."

NATURAL WHEAT-RYE HYBRIDS OF 1918

Nineteen First Generation Hybrids Found Growing in Wheat Plots on the U. S. Government Experimental Farm at Arlington. Vigorous Second Generation Plants are now Being Grown from a Portion of the Seed

CLYDE E. LEIGHTY

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IN a previous article[1] I have described four natural wheat-rye hybrid plants found in 1914. Three of these were found growing in the wheat plots on the Arlington Experiment Farm, of the United States Department of Agriculture, near Washington, D. C., and the fourth was sent me for identification from Tennessee. In each of the three following years, 1915, 1916, and 1917, one or two plants of this unusual hybrid combination were found in the wheat plots on the Arlington Farm. All these plants found in the four years were of the F_1 generation, and all were completely sterile, with the exception of one kernel on one of the plants found in 1915.

In 1918, Mr. William C. Eldridge and I found nineteen natural wheat-rye hybrid plants on the Arlington Farm, and three were found by me in the wheat nursery at the Virginia Agricultural Experiment Station, Blacksburg, Va. A few other such hybrid plants may have escaped notice on the Arlington Farm, although all plots were carefully searched, and others possibly may have been destroyed by a laborer not familiar with their appearance who assisted in rogueing the wheat plots.

The finding of so many of these hybrids is believed to be a matter of sufficient interest to justify this record of their occurrence and this description of them. The plants are further noteworthy because such natural hybrids of wheat and rye apparently have been observed very infrequently. So far as I am aware, no one else in this country has reported in any publication the finding of one of them, but Prof. R. R. Childs recently showed me such a hybrid found by him on the farm of the State College of Agriculture, Athens, Ga. One or more such natural hybrids had also been found by him at that place in both the years 1916 and 1917. In my previous article I cited[2] a possible record of such a hybrid that had been found by Miczynski. Since then I have come across the bare statement by H. Nilsson-Ehle[3] that he had twice seen a spontaneous occurrence of the hybrid between wheat and rye in two varieties of winter wheat which had been pollinated by winter rye growing near by.

WHEAT AND RYE TESTING METHODS AT ARLINGTON FARM

It has been the custom for several years in the variety tests of wheat and rye at Arlington farm to sow the different varieties of rye in plots, usually 1 rod wide and 8 rods long (1/20 acre), separated 4 or 5 rods from each other. This method of sowing is followed in order to reduce the chances for cross-pollination between the different varieties. In the intervening spaces between the rye plots different varieties of wheat are sown, usually in fortieth-acre plots, being separated from each

[1] "Natural Wheat-rye Hybrids." *Journal Amer. Soc. Agron.*, 7: 209-216. 1915.

[2] Fruwirth, C., Die Züchtung der landwirtschaftlichen Kulturpflanzen, Band 4, pp. xvi + 460. Berlin, 1910.

[3] In Beiträge zur Pflanzenzucht, p. 59. Berlin, 1913.

NATURAL WHEAT-RYE HYBRIDS NO. 7 AND No. 9

In the group of four heads shown at the left, the two in the center are hybrids and the two on the outside are heads of the parent wheat. When found in a plot of bearded wheat the hybrid is bearded Wheat-rye hybrid No. 9 is the left one of the two heads shown at the right of the illustration. Most wheat-rye hybrid plants of the first generation (Fl) produce no seed but this head produced *nine* seeds. On the right of it is a head of the parent wheat variety. The illustration is approximately two-thirds natural size. (Fig. 19.)

NATURAL WHEAT-RYE HYBRID NO. 13

Two heads of the parent wheat variety are shown on the outside with two hybrid heads on the inside, the views being taken across and with the spikelets. When found in a plot of beardless wheat the hybrid is beardless. Approximately natural size. (Fig. 20.)

other and from the rye by unsown borders 18 inches in width. The wheat and rye plants growing along the common borders between adjoining wheat and rye plots thus easily may come into actual contact at blooming time. A few rye plants also usually grow among the wheat plants, due to volunteering of the rye or accidental mixing of the seed. These are removed before harvest, but after they have bloomed. Rye pollen is also carried by the wind for considerable distances. It is not an unusual sight to see such pollen being carried by the wind from a rye plot in a thin, dust-like cloud that can be followed by the eye for several hundred feet. There is little doubt that some of this rye pollen at some time or other may fall on every wheat plant in the experimental plots. Many of the wheat and rye flowers bloom at the same time, the blooming periods of certain of the varieties of each coinciding to greater or less extent. There exists then, in the actual contact of wheat and rye plants and in the distribution of rye pollen by the wind, abundant opportunity for the pollination of wheat flowers by rye pollen.

All of these natural wheat-rye hybrids have been found growing in wheat plots and must have had wheat plants as the seed parents. No such hybrids have been found in rye plots, although I have often looked for them. Neither has any one, so far as I am aware, ever made a hybrid between these two species in which the rye was other than the pollen parent. Many hybrids have been made, however, with rye as the pollen parent.

CHARACTERISTICS OF THE HYBRIDS

The hybrid plants found in 1918 are taller than the surrounding wheat plants. Even the shortest culm of a hybrid plant is nearly always taller than the highest neighboring wheat culm. This greater height of the hybrids facilitates their discovery. But the height of the hybrids is less than that of rye plants, being about intermediate in height between wheat and rye.

The hybrid heads are nearly always from 1 to 3 centimeters longer than even the longest nearby wheat head, and the number of rachis nodes of the hybrids is usually from a fifth to a half greater than in the longest wheat head. The hybrids here again in these two respects appear to be intermediate between wheat and rye.

When the wheat in the plot where the hybrid is found is awned the hybrid is awned; when the wheat is awnless the hybrid is awnless or semi-awned. All rye varieties are awned, so the characters found are what would be expected in F_1 hybrids between wheat and rye.

The chaff color of the hybrids is light brown in all cases where the wheat of the plot has brown chaff. In most cases it is white where that of the wheat is white, but in a few cases the hybrid heads are light brown where the wheat chaff was either white or white with a mixture of brown or light brown heads. In these few cases the chaff of either the wheat or rye parent may have been brown or brownish in color, as rye heads often have chaff of a darker brown than that of any of the hybrids.

The peduncle of the rye plant is usually rough and pubescent or hairy for some distance, usually an inch or more, below its junction with the spike or head. It is also solid for about the same distance downward. Plants with entirely smooth peduncle are found occasionally, in certain varieties rather frequently.

Common wheat has a smooth, hollow peduncle of greater diameter than that of rye. These hybrids, with the exception of three, have the upper portions of the peduncles more or less roughened and hairy, but less so than is usual in rye. The three exceptions have smooth peduncles as in wheat. The diameter of the hybrid peduncles is greater than rye and less than or equal to wheat, while usually they have thicker walls and reduced cavity in comparison with wheat. In the smaller culms the peduncles may be solid near the head. There is usually strong evidence of both wheat and rye parentage in the peduncles of the hybrids.

NATURAL WHEAT-RYE HYBRID NO 18

Four hybrid heads are shown in the center with two heads of the parent wheat on the outside. When the wheat variety has rather small heads the hybrid heads are rather small. Compare this with hybrid No. 19. Reduced to approximately two-thirds natural size. (Fig. 21.)

Wheat-rye hybrids are usually entirely sterile. As already stated, only one kernel was produced by all the natural hybrids found at Arlington previous to 1918. Of the nineteen plants found in that year seven produced one or more kernels. Four of them produced only one, the other three produced five, nine, and twenty-two respectively. Of the forty kernels produced, six were classed as well-developed, seventeen as fairly well developed, and seventeen as poorly developed, shriveled or misshapen. Probably most of them will grow, for out of thirteen planted in the greenhouse twelve have produced plants now vigorously growing.

All these kernels are the results of open pollinations. No attempt was made

to pollinate or control the pollination of any of the flowers. It is not known whether the seeds formed are due to self-fertilization or to fertilization by wheat or rye pollen from neighboring plants.

The spikelets of the hybrid plants are from three to five flowered, as in wheat. Rye has two flowers, rarely three, to a spikelet. The shape and size of glumes and lemmas, the several-nerved glumes with ciliate keel as found in the hybrids, all furnish evidence that these are indeed first generation hybrids between wheat and rye.

The conclusion is inevitable that the plants found and here described are first generation hybrids of wheat and rye, the seeds from which they grew having been produced by the natural fertilization of wheat flowers with rye pollen.

THE STERILITY OF WHEAT-RYE HYBRIDS

The nineteen hybrid plants found on Arlington farm bore about 3,500 flowers while only forty seeds were produced. About 1% of the flowers on these plants set seed. Hybrid No. 14 produced twenty-two seeds, a fertility of about 5% of the flowers. This percentage of setting seed is considerably larger than in my previous natural and artificial hybrids of wheat and rye. One artificial and seven natural F_1 hybrids previously examined bore about 1,500 flowers, yet only two seeds were produced, or less than a tenth of 1% of the possible seed production.

Several other experimenters have reported a small amount of fertility in the first generation hybrids of wheat and rye. Carman[4] secured nineteen seeds on ten heads of such a plant, from which he grew large numbers of plants of later generations and finally introduced a wheat variety probably descended from this cross. Rimpau[5] harvested several seeds from a first generation, open-pollinated plant derived by crossing the red Saxony wheat and Schlanstedt rye, from which he grew plants of later generations. Wheat forms segregating out were distributed by him and were grown for several years by several persons and are probably still grown at certain European experiment stations.

Miczynski[6] harvested some seed from a first generation plant, but apparently was not able to get beyond the third generation because of sterility. Jesenko[7] describes four generations descended from certain wheat-rye hybrids made by him. Nakao[8] states that a "few seeds, generally one seed to a few ears," were obtained from an F_1 hybrid, but he could not be certain whether or not they were due to fertilization by the pollen of the hybrid.

Love and Craig,[9] in their work at Cornell University, have secured two fertile wheat-rye hybrids that have now been carried beyond the fourth generation.

McFadden[10] also reports the production of three seeds on an F_1 wheat-rye hybrid plant with twenty-five heads, following the pollination of a few late spikes with wheat pollen. The plants of the F_2 generation winterkilled.

There are probably others who have secured viable seed from F_1 wheat-rye hybrids. Many others are known to have effected the hybrid between these species of cereals, but found the F_1 entirely sterile. From these instances of partial fertility it is evident that seed is occasionally formed, but practically

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[4]For an account of Carman's wheat-rye hybrids see article by C. E. Leighty, in JOURNAL OF HEREDITY, Vol. 7: 420-427. 1916.

[5]Reference to Rimpau's hybrid is made in Fruwirth, C., Die Züchtung landwirtschaftlichen Kulturpflanzen. Band 4, p. 183. Berlin, 1910.

[6]Miczynski: Kosmos r, xxx Lwów. 1905. Citation from Fruwirth *loc. cit.*

[7]Jesenko, F., Über Getreide—Speziesbastarde (Weizen-Roggen) Zeit. für Induk Abs. u. Vererbungslehre, 10: 311-326. 1910.

[8]Nakao, M., "Cytological Studies on the nuclear division of the pollen mother-cells of some cereals and their hybrids," *Jour. of the Col. of Agri.* Sapporo, Japan, 4: 173-190. 1911.

[9]Love, H. H., and Craig, W. T., "Small Grain Investigations." JOURNAL OF HEREDITY, Vol. 9: 67-76. 1918.

[10]McFadden. E. A. "Wheat-rye hybrids. JOURNAL OF HEREDITY, Vol. 8: 335-336, 1917.

NATURAL WHEAT-RYE HYBRID NO. 19

The two hybrid heads are shown in the center and the wheat heads on the outside. When the wheat variety has large heads the heads of the hybrid are large. Reduced to three-fourths natural size. (Fig. 22.)

always in very few of the flowers. Partial or entire sterility of such hybrids is the rule. The 1% fertility in the nineteen natural hybrids here reported, and especially the 5% fertility in hybrid No. 14, is believed to be unusually high.

THE FREQUENCY OF HYBRID OCCURRENCE

It is interesting to note here that eight of the nineteen hybrids here described were found in the practically identical varieties of wheat, Fulcaster and Dietz; four others were found in selections from a hybrid wheat, Crimean x Spelt, and three others in the Purple Straw variety. In only three other varieties were such hybrids found, although several hundred other varieties and strains were growing on the farm No reason for this is known. It cannot be determined from the location of the plots or time of blooming the previous year that greater facilities for crossing occurred in the case of varieties in which hybrids were found. The Purple Straw is one of the first wheat varieties to bloom, while the Fulcaster and Dietz are about average in blooming time.

The season of 1917 at Arlington farm seemed to be uncommonly favorable for cross pollination of cereal varieties. In addition to these wheat-rye hybrids a great many cross-pollinations occurred between different varieties of wheat growing in the cereal nursery, as was evidenced by the number of such hybrids found in the nursery there in 1918. Dr. H. V. Harlan, Agronomist in Charge of Barley Investigations, also reports the finding of a considerable number of F_1 barley hybrids in his 1918 Arlington nursery. These were especially noticeable in a plot of beardless barley.

Of the nineteen natural wheat-rye hybrids described in this paper eighteen were from seed that was grown the previous year on Arlington farm. Hybrid No. 18 was from seed that had been produced at the Agricultural Experiment Station, Stillwater, Okla. A head of the Malakov variety was sent to the Office of Cereal Investigations in the fall of 1917, and seeds from it were sown in a 5-foot row. In this row hybrid No. 18, shown in Fig. 21 was found.

As stated above, three natural wheat-rye hybrids were found in the cereal nursery of the Virginia Experiment Station at Blacksburg, Va., in 1918. No data were obtained on these, Mr. F. K. Wolfe reporting that, on account of lodging, the hybrid plants could not be found at harvest time.

Several natural wheat-rye hybrids have been found, as stated above, on the farm of the State College of Agriculture, Athens, Ga.

In my previous article (*loc. cit.*) I reported on a hybrid sent to me from Brush Creek, Tenn.

Natural wheat-rye hybrids have occurred, then, in five different localities of the United States. I examined a considerable number of wheat fields in which rye was mixed in New York State in 1918, and a few such fields in Kentucky, but did not find hybrids of wheat and rye.

Summary.—Nineteen natural wheat-rye hybrids were found on Arlington farm in 1918, and three were found at the Virginia Agricultural Experiment Station. From a study of the plants and comparison with wheat and rye and with known hybrids between these species, it is evident that these hybrids are all of the first generation (F_1). They must have developed from seeds formed by the natural fertilization of wheat flowers with rye pollen.

Forty seeds were produced by these plants, approximately 1% of the flowers setting seed. Vigorous plants of the second generation are being grown from a portion of this seed.

The natural hybridization of wheat and rye is now known to have occurred in five different localities of the United States—in northern and southwestern Virginia, in Tennessee, in Georgia, and in Oklahoma.

WORLD-POWER AND EVOLUTION

A Review of Dr. Ellsworth Huntington's Evidence of how Climate has Affected the Development of the Human Race and Determined the Periods of Greatest Achievement

PAUL POPENOE

THE effect of changes of climate on human activity, not only physical but more particularly mental, is the thesis of this[1] as of several preceding books by Ellsworth Huntington.

Beginning with present-day conditions, he shows that business cycles, as measured by bank clearings, financial depressions, periods of credit expansion, and the like, correlate with the general conditions of health in the eastern United States. He measures health, for this purpose, by fluctuations in the death-rate, and then proceeds to show that these fluctuations correlate positively with changes in temperature, so that even a small deviation from the optimum temperature in either direction causes an increase of deaths.

The most favorable conditions under which human beings can live, he concludes, are a mean temperature of 64°F., for physical activity, with a good deal of humidity and frequent changes in temperature, while for mental activity he finds a mean of 40°F. better suited.

These conclusions are based on extensive statistical data, partly analysed in the book under review and partly in previous volumes. The statistical methods used are somewhat crude, but probably the data available are not sufficiently precise to justify more refined treatment. Dr. Huntington has made out a plausible and interesting case for the importance of climatic changes in daily life; future and more exact investigation will determine the limits.

In his latest book, Dr. Huntington inquires why there is a difference between the most favorable temperature for mental activity and that for physical activity. He explains by saying that these adaptations were made at different periods in the history of the race, when the air was different.

THE IMPORTANCE OF AIR

"Long before man's earliest ancestors had become different from the beasts the whole world of life had realized the necessity of air," he remarks. "Even the creatures that inhabit the water can live only by taking from it the dissolved air. Otherwise the chemical activities which are the basis of all life come promptly to an end. Before these primitive animals could give rise to higher forms, however, it was necessary that they should pass through a series of crises. Each of these crises was a step forward in the estate of man. Each has left its impress not only upon the animal world but upon the human race.

"A few of these crises, such as the development of vertebrates from invertebrates, were due to causes other than climate, but most arose directly from the conditions of the air which we call climate. Let us consider three of the chief crises.

"The first was the emergence of the earliest vertebrates from the water. This was a most momentous step, for only in the highly varied environment of the land does brain power develop rapidly. Creatures like the seal, the whale, and the manatee, which have gone back to the water from the land,

[1] "World-Power and Evolution," by Ellsworth Huntington, Ph. D., Research Associate in Geography, Yale University; author of "Civilization and Climate," etc. Pp. 287, with maps, etc. Price $2.50. New Haven, Conn.: Yale University Press, 1919.

fall behind in the mental race, for they are not sufficiently stimulated.

"The second great crisis was the change which caused certain forms of life to become warm-blooded. This not only enabled man's animal ancestors to continue their vital activities at all seasons and in almost all parts of the world, but it gave rise to the close bond between mother and child which has been the greatest of all factors in promoting the higher qualities of love and altruism.

"The third great crisis was the separation of man—the two-handed, two-footed, big-brained creature—from his four-handed and smaller-brained relatives. This was the time when mental qualities evolved most rapidly. Therefore it interests us most of all because the conditions which fostered the evolution of our minds are those which today stimulate them most strongly.

"It is perhaps a misnomer to speak of these as crises, for each of these three steps in evolution required a long time for its consummation. Yet as we look backward into the dim vistas of the past, the steps are so foreshortened that they appear like genuine crises. They are, as it were, great slopes in a terraced plain. For long periods the life of the world was confined to the waters. Then during a relatively brief period, as geology counts time, there came a transformation. The highest forms that inhabited those ancient seas—that is, the fishes—gave rise to a stock which left the water and made its home on land. Then our ancestors, for such they were, moved on once more across the vast plain, rising here and there over smaller terraces, until at last they began to climb to the warm-blooded condition. Another vast stretch of plain and minor terraces brought them to the final steep upward slope. At its base our ancestors were animals; at its top they were men.

MORE PROGRESS TO COME

"But have we yet reached the top? More likely we are now upon the very steepest part of the terrace. Hitherto we have climbed upward because some unknown force kept driving us. Now we are conscious of ourselves, and are able to direct our movements. It is for us to say whether we will climb straight upward, or whether, like many of the creatures of the past, we will wander this way and that, and perhaps fail to be among the chosen few who finally emerge at the highest level."

It was the aridity of the air during the Devonian period which caused the development of amphibians with legs and lungs, Dr. Huntington surmises; while a second long drought in the Mississippian period, millions of years later, caused all those to perish except the ones that could lay their eggs on land and did not have to return to the water. Thus the reptiles were established and the first crisis, the transition from water to land, had been weathered.

"Not till millions of years later did the next great step in evolution occur. That step was the rise of the warm-blooded mammals. We do not find their fossil record until the time known as the Upper Triassic, but they must have originated farther back, apparently in the Permian. The date of the Permian Period is estimated as anywhere from 10,000,000 to 200,000,000 years ago. The break between the types of life before and after this great crisis is the most profound anywhere in the history of evolution. It is therefore highly important to find that this was also the time of the greatest changes of climate. Vast glaciers descended to sea level within 30° of the equator. Perhaps at no other time during the evolution of man's ancestors has there been such a succession of cold, stormy, glacial epochs alternating sharply with mild, interglacial epochs.

"Let us consider the effect of such climatic stress upon other forms of life as well as upon our ancestors. Previous to the Permian Period the vegetation of all parts of the earth's surface, including even the far north, was much alike. In general the lands were covered with forests, averaging perhaps

40 feet in height, but with some trees towering to 100 feet. Schuchert describes it as a forest of rapid growth, of soft and even spongy woods, in which evergreen trees with comparatively small, needle-like leaves were prominent. Associated with these were thickets of rushes, also of very rapid growth, which in habit resembled modern cane-brakes and bamboo thickets. Here and there stood majestic tree-like ferns, while many smaller ferns and similar plants thrived in the shady places or climbed among the trees. Flowers of a certain sort were sparingly present, but of insignificant size and unattractive color. Spores took the place of seeds to such a degree that when the trees and ferns were liberating them the entire forest was covered with a greenish-yellow or brown dust. During the Permian Period the sharp transitions from cold to warm, or from moist to dry, caused these ancient forests to die out. Conifers much like those of today came into existence. Seeds largely took the place of spores. These changes were accompanied by a general reduction in the size and variety of plants, and by a tendency for them to become hardier and to have thicker and less ornate leaves.

CHANGES IN ANIMAL LIFE

"During the great climatic changes of the Permian, animal life suffered an even greater transformation than plant life. For example, previous to that time the insects had been of truly astonishing size. Out of the 400 forms known in the early and middle parts of the Pennsylvanian Period which preceded the Permian, the smallest had wings over a third of an inch long. The wings of more than twenty species were 6 inches long, six attained to nearly 8 inches, and three were giants of 12 inches. Imagine a spore-dusted forest full of insects as large as crows! The cold and changeable climate of Permian times apparently caused the extinction of all these forms. Their place was taken by small species resembling those of today. Moreover, the very nature of insects was profoundly modified by the introduction of metamorphosis. That is, where there had formerly been merely a gradual growth from the egg to the adult, there was now a growth from egg to maggot or caterpillar, then a resting period, and finally a transformation from maggot to fly or from caterpillar to butterfly. At the same time the insects acquired the power to become dormant and thus persist for months at a time. All these changes were apparently due to the necessity for adapting themselves to sudden periods of drought or cold during the time of growth in summer, or to the necessity for enduring long, severe winters. Thus the climatic variability of the Permian Period not only caused a remodeling of the earth's garment of vegetation, but introduced a unique stage into the life history of insects.

"For our present purpose another change is far more important. At this time apparently there occurred one of the most vital steps in the evolution of our direct ancestors, the mammals. Extreme aridity and low temperature were both characteristic of certain epochs of the Permian Period. Among the more progressive types of land animals aridity has a tendency to accelerate development. It places a premium upon the power to travel, and especially upon speed. As Lull puts it: 'Not only are food and water scarce and far between, but the strife between pursuer and pursued becomes intensified—neither can afford to be outdistanced by the other. This means increased metabolism, which in turn generally implies not only greater motive powers but higher temperature. With increasing cold a premium would be placed upon such creatures as could maintain their activity beyond the limits of shortening summers, and this could be accomplished only by the development of some mechanism whereby a relatively constant temperature could be maintained within the animal regardless of outside conditions.' In other

words, there arose warm-blooded animals whose temperature was more or less independent of the surrounding air instead of varying with it as is the case in cold-blooded animals. Among mammals this led to the production of the young within the body of the mother, instead of from eggs in which the mother took little or no interest after they were laid. Among birds it forced the mother to care for the eggs if they were to be hatched. Thus the relation of mother and child became firmly established. The latter development of this relation has been the chief source of all that is best in mankind."

THE AGE OF REPTILES

All this, of course, was a slow development. Gigantic reptiles lorded it on the earth in those days, and the mammals were little beasts skulking in out-of-the-way corners, perhaps in the hills rather than on the lowland plains.

"Once more we must skip millions of years. The mammals have grown in size and variety until they range from the mouse to the mammoth. They have ousted the reptiles from the best parts of the earth. They have taken to the air with the wings of the bat, they have gone back to sea with the whale, they have learned to run like the antelope, to burrow like the mole, and to climb trees like the squirrel. Their limbs have become hoofs, claws, wings, flippers, and hands. The Age of Mammals has come to its epiphany. Then as in Permian times, there once more comes a widespread period of climatic stress, the last Glacial Period. A new element enters into its evolution, for at last man appears and intelligence becomes dominant.

"When the mammals had reached a condition of complete dominance they were suddenly wiped out wholesale. In North America the whole family of horses was destroyed; the elephant tribe, including the mammoth and mastodon, disappeared; the camel, which had formerly been abundant, passed away, leaving no trace save his bones. Still other great families such as the giant beaver, the sloth, the tapirs, and the so-called glyptodonts were likewise exterminated. In Europe there was a similar appalling destruction of life.

"Directly or indirectly all this destruction arose from the severe climatic oscillations of the Glacial Period, for this one period included four great 'epochs.' It was apparently the Glacial Period which chiefly stimulated man's mental development and caused his intelligence to dominate the earth. Previous to the Glacial Period the brain of man's animal ancestors had been evolving very slowly for hundreds of millions of years. During the half million years more or less of the Glacial Period previous to the time we have now reached, that is, previous to the last Interglacial Epoch, it had been increasing at a rate vastly faster than formerly. Yet at the time of the Piltdown Man [100,000 to 150,000 B. C.?] the human animal, as we may perhaps still call him, had made almost no advance in the use of material resources. His weapons were probably nothing but stones, bones, and sticks that he broke with his hands. His most elaborate manufactured instruments were flints of the rudest sort. These were merely thick chips roughly flaked a little to increase their cutting power. So far as we yet know, man was still ignorant of the use of fire.

THE NEANDERTHAL RACE

"In those days the climate of Central Europe was apparently somewhat milder than at present. This mild climate continued for a long time, approximately 50,000 years according to Osborn's chronology, which we are now following. During this time the region from northern Spain and Italy to southern England and western Austria, whence our knowledge of early man is chiefly derived, was peopled by the Neanderthal race. These people appear to have been a little more advanced than the Piltdown type, but their brains were distinctly smaller than

those of the Europeans of today. Little by little their power and skill increased. Yet even at the end of the period of mild interglacial climate, they were still extremely primitive. They had no esthetic art so far as we know. Their greatest exhibition of skill was in 'flaking' the edges of flints to produce sharp cutting edges. This they did with great skill, producing implements of beautiful symmetry and considerable utility. Doubtless they had other arts, such as the dressing of skins, the building of huts, and the making of wooden clubs. Yet how little this represents in proportion to the hundreds of thousands of years since man first began to chip the flints that he picked up from the ground! Only at the end of this last Interglacial Epoch do we find the first positive evidence that man had learned to use fire.

"We now come to a strange and most significant fact. Man had lived through three great glacial epochs, but he had never been subjected to a really severe climate. Now for the first time he endured one, for the last epoch was much more rigorous than its predecessors. At the same time his evolution proceeded much more rapidly than ever before.

"The approach of this severe climate was gradual. First there was a long period of relatively cool, dry conditions. Central France, for example, may have been something like what southeastern Russia now is. This caused the disappearance of two rather sensitive Asiatic mammals, the hippopotamus and the southern mammoth. Then, as the Scandinavian ice-sheet accumulated farther north, the climate became more severe. Men repaired to the shelter of grottos and caverns as they had not for tens of thousands of years. The hardy, broad-nosed rhinoceros and the straight-tusked elephant both disappeared, while animals of the cold Arctic tundra, such as the reindeer, the wooly mammoth, and the wooly rhinoceros, and the Arctic lemming, migrated all over southern Britain, Belgium, France, Germany and Austria.

PROGRESS IS CHILLED

"This condition was too severe for early man. The stage of human development, which coincides with the *beginning* of refrigeration, 'is seen to present the climax of a gradual and unbroken development' not only in industries but in ideas. The next industrial stage, which certainly presents the closing workmanship of the same Neanderthal race, and which coincides with the main cold period of the Fourth Glaciation, 'shows a marked retrogression of technique in contrast to the steady progression which we have observed up to this time.'

"The climatic conditions which were unfavorable to development in central Europe seem to have been highly favorable in other places where they were not quite so severe. Thus somewhere in central Asia there appears to have developed during this period the great Cro-Magnon race. These highly gifted people had brains as large as those of modern Europeans. They invaded southern Europe after the most severe part of the fourth Glacial Epoch had passed away. 'After prolonged study of the works of the Cro-Magnons, one cannot avoid the conclusions that their capacity was nearly if not quite as high as our own; that they were capable of advanced education; that they had a strongly developed esthetic as well as a religious sense; that their society was quite highly differentiated along the lines of talent for work of different kinds.' The civilization, such as it was, of the Cro-Magnons 'was very widely extended. This marks an important social characteristic, namely, the readiness and willingness to take advantage of every step in human progress, wherever it may have originated.'

"These fine people lived in Europe from about 25,000 years ago until 7,-000 years ago. Their art was perhaps their greatest claim to fame, for their drawings and paintings on the walls and roofs of caverns were wonderful, considering the primitiveness of the tools they employed. Why they dis-

appeared we do not know. They were not the ancestors of most of the modern Europeans. They may have been fair-haired like the Nordics, but they had peculiarly broad faces and relatively narrow heads unlike any of the present great races.

THE GREAT MODERN RACES APPEAR

"They were displaced by other races, the long-headed dark Mediterraneans, the broad-headed, brown-haired Alpine people, and the tall, fair-haired, blue-eyed, long-headed Nordics. These later races, which have carried civilization forward by leaps and bounds, appear to have risen to their present mental power during this same last Glacial Epoch. The place of their origin is not quite certain, but their common center was quite surely in Central Asia not far from where the Cro-Magnons developed. In that same region dwelt the ancestors of the races that evolved the early civilizations of China, India, and Asia Minor, and at least a part of the Mesopotamian civilization. There, in an environment not quite so severe as that of central Europe, these early people developed the art of smoothing stone implements and evolved other capacities which enabled them to conquer the artistic Cor-Magnons. There, too, or else in the not greatly dissimilar climate which then prevailed in North Africa, the art of copper smelting was invented. A little later, in essentially the same Asiatic regions, the far greater art of making iron tools was developed, and man took still another of the great steps which mark his advance toward civilization.

"In view of these facts and many others it is hard to avoid the conclusion that the last Glacial Epoch and the succeeding period of less pronounced climatic changes were peculiarly stimulating to mental development. The coldest places were not favorable, but on their borders where the climate was severe enough to be highly bracing, but not benumbing, there occurred an extraordinary development of brain power. As evolution counts the years we are still too near to see this development in its true light. Yet it can scarcely be mere chance that man rose above the animals during a great glacial period such as that which directed the wonderful evolutionary changes of the far earlier Permian Period.

"Still less is it likely to be mere chance that the evolution of the powers of the human brain was relatively slow until the last of the four great epochs into which the Glacial Period is divided. That last epoch was colder and more severe than any of the others. Close to the ice-sheets it was apparently so severe that it caused retrogression, but farther away it apparently provided conditions such that man changed a thousand times faster than the animals had changed during the vast periods of relatively uniform climate in earlier geological times. . . . Clearly a severe climate is wonderfully potent in hastening the course of evolution."

SEEKING AN EXPLANATION

This last conclusion would doubtless be accepted by all biologists, since a rigorous climate means an intensity of natural selection that perpetuates favorable variations. But Dr. Huntington seeks a more direct intervention of climate in evolution and devotes a chapter to "New Types among Animals," in which he argues that the effect of climatic changes is to induce sudden, inheritable mutations.

This, of course, is an old stamping-ground for biologists, and they will not consider that he has made out a strong case; nor does he claim that the evidence is now conclusive. He bases his hopes on a few well-known experiments such as: (1) the effects of changes of temperature on the pupae of butterflies; (2) W. L. Tower's work on potato-beetles; (3) experiments on drosophila under extremes of temperature; (4) P. Kammerer's work on toads; (5) F. B. Sumner's experiments with mice; and (6) A. H. Clark's observations on crinoids from different regions. Some of these ex-

periments are not taken very seriously by biologists in general, while the good ones are susceptible of various explanations, and it is by no means evident that they are of a character to produce the great evolutionary effect that Dr. Huntington would ascribe to them.

The long quotations that have been given are sufficiently illustrative of the manner in which Dr. Huntington interprets the facts, and it is impossible here to review the chapters in which he ingeniously applies his hypotheses to ancient and modern history, taking up the Greeks, the Romans, the Jews, the Negroes, the Germans, the Turks, and indeed most of the races and nations of the earth, and seeking to show that their achievements coincide with favorable climatic conditions, their failures correspond to unfavorable ones. The book must be read, and few will regret reading it.

"Some readers," Dr. Huntington warns, "may feel that the importance of environment is exaggerated in this book. That will be largely because they do not attach as much weight as does the author to the qualifying phrases which he has used. A few generations ago the emphasis was all upon the various agencies which combine to furnish *training*. In a broad sense these include the Church, the Home, the School, the State, and other institutions. Recently tremendous emphasis has justly been given to another factor, namely, *heredity*. We are told that heredity plays nine parts and training one in determining what a man's character shall be. According to such an extreme view *physical* environment is scarcely worthy of mention. Yet training, heredity, physical environment, are like food, drink, air. One or another of these may be placed *first*, according to the individual preferences, and one or another may demand more attention according to the circumstances. It is idle, however, to say that one is any more important than the others. All are essential. Until the world learns this vital lesson, it will be necessary that some students should lay special stress upon heredity because its importance is not yet so fully recognized as is that of training. Other students must lay still greater stress upon physical environment because its importance is still less appreciated. When the world realizes that the human race must be bred as carefully as race horses, and that even when people inherit perfect constitutions their health must receive as much care as does that of consumptives, it will be time for a book in which training, heredity, and environment receive exactly equal emphasis."

THE AUTHOR'S POSITION

Again, at the close of the book, Dr. Huntington makes a final effort to avoid misunderstanding. "Today the swing of evolutionary thought is all toward the side of heredity," he explains. "Therefore scores of biologists will feel that in placing so much emphasis upon the effect of environment I have committed a cardinal sin. They will say with justice that there is far more proof of the importance of heredity in causing stability from generation to generation than of the importance of environment in creating mutations.

"Undoubtedly the evidence as to the cause of mutations is still slight. That is inevitable when a subject first comes into the realm of scientific investigation. On the basis of such scattered facts as are yet available we have framed the hypothesis that the commonest cause of mutations and thus of the origin of species is germinal change due to the action of extremes of heat and cold upon the organism in its early stages of growth. If such an hypothesis is accepted, it will doubtless demand a readjustment of many old ideas, but there is nothing about it at all inconsistent with the strongest possible belief in the importance of heredity.

"The scales have swung too far in one direction because one side has been weighted with some of the most important and interesting facts that have ever been discovered. Now we

must find facts of other kinds and throw them into the scales. It happens that the facts set forth in this book fall into the side of the scale marked environment. By and by we shall have more facts. As we dig them out we must carefully inspect them to see whether they belong in one scale or the other. It is easy to mistake the scale in which a given fact should fall, and sometimes we may have done so in this book. Yet even so there remain many facts which indicate that extremes of heat and cold, moisture and dryness, are somehow associated with pronounced changes in the form and function of organs of the body. This single fact, if it be a fact, is more important than all else that we have here discussed. Part of its importance lies in that it opens up the possibility that some day mankind may learn not only how to select the best variations in a given plant or animal, but how to cause a great number of widely diverse mutations from which he may select.

"In all this the human race is merely one among the species of animals. For aught we know, his migrations and the many new and artificial conditions to which he subjects himself may be altering some of his most deep-seated qualities. We spend millions in the attempt to improve plants and animals. Is it not time that we learned how the highest of all the animals is being changed and how his future evolution may be directed along the right path?"

Morgan on Heredity

The Physical Basis of Heredity, by Thomas Hunt Morgan, professor of experimental zoology in Columbia University. Monographs of Experimental Biology; the J. B. Lippincott Co., Philadelphia, 1919. Pp. 305, with 117 illus. Price, $2.50.

During the past twenty years the nature of the process of inheritance has been demonstrated in detail to the satisfaction of nearly every one, and no man has had a larger part in this great accomplishment than Dr. Morgan. The present book is the most complete account extant of the mechanism of heredity, and it will therefore be indispensable to every serious student of the subject, even though in some respects it will not at once supplant "The Mechanism of Mendelian Heredity," which Dr. Morgan and his associates published in 1915.

All of the important or moot points of the subject are discussed, and difficulties are met squarely, except in a few instances, as in a discussion (p. 36) of the objection that Mendelism deals only with superficial characters, such as color. This is on its face a fundamental objection, and the only answer Dr. Morgan makes is to cite the well-known lethal factors that destroy the individual when homozygous. "There can be no question as to the fundamental importance of such factors," he truthfully states; but certainly this does not answer the attack, and it might as well be admitted that the characters whose inheritance has so far been worked out satisfactorily are in general superficial characters. It is easy enough to see that any important structure or function must be due to the interaction of a large number of factors, and it is no cause for apology that geneticists have not yet been able to isolate all the factors that go to make such a character.

The book contains a good bibliography, which brings a fresh realization of the great amount of work that has been done in genetics in the brief time that it has existed as a science.—P. P.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

Vol. XI, No. 4 April, 1920

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The Journal of Heredity is published monthly by the American Genetic Association (formerly called the American Breeders' Association) for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $2.00, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $2.00 a year, foreign postage extra; price of single copies, 25 cents.

Entered as second-class matter February 24, 1915, at the postoffice at Washington, D. C., under the act of August 24, 1912.

Date of issue of this number, June 6, 1920.

A NATIVE CHINESE OR TIBETAN PONY AT CANTON

Its native home is in Tibet and along the western border of China, and it is particularly well suited to the needs and conditions of those regions. Horses are used there chiefly for riding and pack carrying, and the soundness of the native pony, combined with its lightness, make it well adapted to the narrow roads and suspension bridges. (Frontispiece.)

NATIVE HORSES AND CATTLE IN THE ORIENT

Future of the Livestock Industries of China Outlined—Possibilities for Development of Great Meat and Dairy Resources if Modern Methods of Care and Breeding Are Introduced

C. O. Levine

Associate Professor of Animal Husbandry, Canton Christian College

HORSES, donkeys and mules have been little used in China, except in the northern and western provinces where they are used almost solely as pack animals and for riding. The southwest and western border of China, and Tibet, is the native home of the Chinese pony, which in literature is referred to as the Tibetan pony. Up to the present time no horses have been raised in Kwangtung. Horses from the western provinces are shipped to Kwangtung chiefly from Yunnan. The Chinese, or Tibetan pony, is an excellent pony for this region. It thrives well in this climate, and its size—it usually weighs about 500 pounds—is well suited to the narrow roads and "coffin-board" bridges. It is a beautiful animal, and the better ones are intelligent and easily trained by one who understands horses, provided the horses have not been previously spoiled by improper handling. They have good enduring powers, and seem quite free from diseases and unsoundnesses. They have colors common among other horses—black, white, sorrel, bay, piebald, gray, white, iron gray, with bay predominating.

THE MONGOLIAN HORSE

The Mongolian horse is quite common in the north of China. It is considerably larger than the Chinese pony, weighing about 700 to 800 or more pounds. It is of interest to students of horse breeding because of the fact that it is supposed to be the ancestor of most of our modern breeds of horses. It is raised in Mongolia in a semi-wild manner, much as the mustangs or Indian ponies were raised in the United States on the western plains up to recent years. It is a strong and swift horse, and is said to be fairly free from diseases, but does not do well in the south. As a rule those observed by the writer have not appeared as handsome as the Chinese ponies. It is the horse that is used in the annual races of Shanghai and Hongkong. It is not very popular in Canton, where there are only about 50 Mongolian horses as compared with about 250 Chinese ponies.

HORSES IN CANTON

While the number of horses in Canton is at present small the demand for horses for riding and carriage use in Canton is rapidly increasing. Some of the livery barns recently have imported mares from the western part of China and have begun to raise ponies in Canton. There are few mares in Canton other than those recently imported for breeding purposes. The males are seldom castrated.

As a rule the Cantonese take good care of their horses, keeping their animals in good condition.

The usual concentrated feed for horses in Canton is corn, rice chop, and wheat bran. Green grass and rice straw are fed as roughage. The grass and straw are usually cut into short lengths before feeding. Rice is always cooked for the horses, as well as for other classes of livestock.

CHINESE CATTLE

Shantung, Chihli, and Honan provinces in the north, and Szechwan, Yunnan and Kwangsi provinces in the southwest, produce cattle in largest

numbers. Conservative estimates would place the number of native cattle at 50,000,000. The total value of these at $30.00 (Mex.) a head would be $1,500,000,000 (Mex.). The export of cattle from China to other countries is small but is increasing from year to year. According to the customs reports, exportation has increased from 1,000 to nearly 100,000 cattle a year during the past four years.

Shantung is one of the biggest cattle producing provinces in China. The Japanese report referred to above has the following to say about the cattle in this region:

"Generally speaking the Shantung cattle are large in build. As for the ox, it usually weighs from 600 catties (1.33 pounds equal one catty) to 1,000 catties, with well developed loins and legs which almost form a rectangle shape. According to a native, a German missionary once imported here cows of a foreign breed with which he undertook the improvement of cattle in this locality, and that was the foundation of our cattle of the present day. . . . Judging from the fact that the Shantung cattle have a comparatively thin hide and have a tendency to early growth and fattening, we can safely infer that they are not a pure breed but improved species. Most cattle now in Shantung were brought over from Honan. Although they are called Shantung cattle there is no doubt but that they are the product of Central China. That is to say, they have gradually migrated eastward from Honan, Shonsi, Shansi and Kansu which are situated in the center of continental China. The Yellow River which passes through these territories makes the vicinity of its water course unfit for cultivation by the tremendous overflow of the river which takes place every year. In consequence the district forms one vast pastureland of thick weeds. Any person going through there will notice the thriving industry of cattle raising. As explained above the territories from which Shantung cattle come cover vast areas and naturally the number of cattle available may be said to be almost limitless.

"The method of raising cattle is very simple. In the country districts it is not uncommon for one to find from thirty to sixty head in one small village. Every farmer usually keeps from five to six head which are usually taken care of by one coolie. When cattle are not employed they are turned loose on the fields where they feed as they like. The coolie usually is a young lad who is called 'Cattle watcher.' His wage is usually 5 to 6 sen per day. At night he sleeps in the cattle shed. Cattle are fed three times a day, morning, noon, and evening, during the busiest season of farming. In seasons when farming is not in full swing they are fed twice a day—morning and evening. The feed then consists of about 16 catties of straw and 4 catties of mixed feed a day. The straw fed is mostly millet, but wheat straw is fed also. In some places dry peanut stems and sweet potato vines are fed. The mixed feed mentioned above is composed of kaoliang, beans and the like, mixed with cut straw or hay and water.

"Although Shantung cattle may not be as good as Japanese cattle for beef, yet it is an established opinion that they are far better than Korean or Mongolian cattle. At the time of the German administration in Tsingtau efforts were made to improve the cattle. They always kept cattle of foreign breeds in their slaughterhouse with which they undertook to better the Chinese cattle. Promising calves were purchased by the authorities. When they were one year old the German doctors brought them together and held an exhibition. Prizes were awarded for good cows, which were later bred to cattle of foreign breeds. By means of such encouragement and others, the improvement of cattle in this district was induced."

THE NATIVE "HUMPED" CATTLE

The methods of caring for and feeding cattle in Shantung, described by the Japanese authorities, are the same as those generally followed by the Chinese. The feed, however, differs in the various localities. In the Canton region the grain fed is usually rice chop and wheat

TIBETAN OR NATIVE CHINESE PONY

The native Chinese ponies have all the varying colors that are common to other breeds of horses, but bay predominates. They weigh usually about 500 pounds, and possess strong powers of endurance. (Fig. 1.)

bran. The cattle in the Canton region are not as large as the Shantung cattle, if the Japanese estimates are correct. The average cow in the south weighs 500 catties, and the average bull 800 catties, though some individual cattle have been noted that weigh as much as 1,000 catties when fat.

The native cattle of southern China are of the humped species common in the Orient. In most of the natural histories they are called Zebus. The main difference between these cattle and the European cattle (Bos taurus) is in the enlargement or protuberance on the top of the shoulders. This prominence in the bulls sometimes is as much as ten inches above the level of the back. The females of the variety common in China have, as a rule, only a small enlargement on the shoulders. The meat in the hump is said to be of good quality. The breeds of a related species in India (Bos indicus) are characterized by a larger hump and by a heavy fold of skin which hangs like a curtain from the throat to the brisket of the animal.

The color of the cattle in China is much like the color of Jerseys. It varies from a yellow red to a brown red and almost pure black. Spotted or white cattle are not common, chiefly because the meat of an animal with white color markings is considered inferior. Fawn is quite a common color. The nostrils are black with a grey or mealy colored ring around the muzzle just above the nostrils. The tongue is black. It is a peculiar coincidence that all of the above color characteristics of these cattle are also true of the Jerseys. While the amount of milk yielded is very small—so small that cows are seldom used for milking—the fat content is high, varying from 5 to 8 per cent.

THE "HUMPED" CATTLE IN HONGKONG MARKETS

Although the cattle from different districts of southern China, are much alike in color and conformation, there is some difference in types in different communities.

There are three distinct grades of cattle, for instance, that reach the Hongkong market, coming from different regions. Those coming from the east coast of Kwangtung province, from the region south of Swatow, are superior in size and beef characteristics to those raised in the region of Canton, and their dressed meat sells on the average for 27 cents (Mex.) when Canton beef sells for 24 cents. Cattle from the west river region, or above Wuchow, are of a type just between the Canton and Swatow cattle. They are somewhat better than the Canton cattle, but not as good as those from the Swatow region. Cattle are sold by the head, and not weighed. The usual price for a fair individual weighing from 600 to 800 pounds is from $28.00 to $50.00 (Mex.).

THE FUTURE FOR LIVESTOCK IN CHINA

The production of better and more live stock in China must come as the country develops industrially and commercially. Good police protection, good roads and railways, a demand for export products and an increasing demand for milk, will all be incentives to expansion of the livestock industries. There is enough grass on the hills of China, now not being utilized except for fuel, to produce at least twice as many cattle as are being produced today. Cattle sell for about one-half the price they sell for in America. Better prices offered for export beef, which will come with development, will stimulate the beef industry, and the demand for milk within China itself must be met. With the present prices received for milk (12 to 18 cents local currency per pound) and the price at which imported butter is sold, ($1.20 local currency per pound) there are few other industries that offer better opportunities for young men well trained in the principles of dairying and breeding and with a thorough knowledge of the methods of producing sanitary milk, butter, and other dairy products.

IMPROVEMENT OF LIVESTOCK

With the development of agricultural industries will come a demand for the improvement of the different classes of livestock now raised in China. Three

methods of improvement suggest themselves.

The first method, and no doubt the best, is that of improvement within the breed, without the introduction of foreign blood. A few generations of intelligent selection of individuals for breeding purposes should greatly improve the cattle for beef purposes. Because of the small amount of milk given by native humped cows, draft and beef production will probably always remain the function of this class of cattle. Breeding for improvement without the introduction of foreign blood should be followed with all classes of live stock, no matter how extensive the use of modern breeds may become.

The buffalo in China has been chiefly a draft animal to be used for beef as soon as its usefulness for work is ended. In recent years some dairies in the south have begun to use the buffalo for milk, and now have cows that give more than 12 pounds of milk a day, testing from 10 per cent to 15 per cent fat. Six buffalo cows at the Canton Christian College, for which records for complete lactation periods are available, have produced an average of more than 250 pounds of butter fat.

A second method of improvement would be to introduce males of improved breeds for mating with native cows.

Crossing the native cattle with modern breeds of beef cattle should no doubt improve the native cattle for beef purposes. However, such crossing of native humped breeds of cattle with European breeds has not proven popular in the Philippines and in India for the reason that while the cross produces better beef cattle, such cattle are of little use for draft. The chief reason why the native cattle are so well adapted for work is because of the hump against which the yoke fits so well. In animals containing foreign blood the hump is very small, or not present at all.

A third method suggested for improvement of native live stock is to secure pure bred animals of desirable breeds and continue to breed them pure.

The first method suggested, that of selection within the native breed for improvement, is safest, but slow in bringing results. Introducing modern improved breeds will probably bring quicker results, provided good, healthy individuals only are secured and intelligent breeding is practised. However, the disease common here, and not common in regions from which imported cattle come, should be taken into consideration and guarded against, or the result to individual breeders is apt to prove disastrous financially. Great care should be taken not to introduce tuberculosis with European breeds.

NEED OF TRAINED LIVESTOCK MEN AND VETERINARIANS

Men trained in animal breeding and feeding, are much needed in China to improve the quality of livestock by intelligent feeding, care, selection and breeding, and by introduction of foreign breeds. Veterinarians are needed to take up a thorough study of diseases and their control, and to build laboratories for the production of anti-cholera and anti-rinderpest serums for the prevention of these two great plagues of the livestock industry. Canton, like all cities in China, is in need of government livestock sanitary inspectors with adequate laws to support them, to prevent the sale of diseased meat, and above all the sale of unwholesome milk; for while the danger of eating diseased meat is serious enough, the danger of contracting typhoid fever, tuberculosis and other disease from contaminated milk is apparent to all. Every cow with European blood, whose milk is being sold to the public, should be tested for tuberculosis and reacting animals be rejected for dairy purposes. Such work is the work of a veterinarian. It should not be necessary to test native cows or buffalos, as the native cows are highly resistant and the water buffalo apparently immune to tuberculosis.

Some of the dairies have good bulls of modern dairy breeds, but cannot produce good milkers because of their methods of raising calves. From the time the calves of these European cows are born they are kept tied up in a

A MONGOLIAN HORSE

The Mongolian horse is much larger than the native Chinese pony, weighing from 700 to 800 pounds. It is said to be the ancestor of most of our modern breeds of horses. It is common in the north of China, but does not do well in the south. In Canton there are only one-fifth as many Mongolian horses as there are native ponies, but the former are the horses used in the races at Shanghai and Hongkong. (Fig. 2.)

barn and are never turned out, even in a dry lot, to exercise. Naturally, the cows in even the best dairies are poor milk cows, small in size, some with every indication of tuberculosis, and giving an average of from 15 to 20 pounds of what is very probably contaminated milk each day, while if

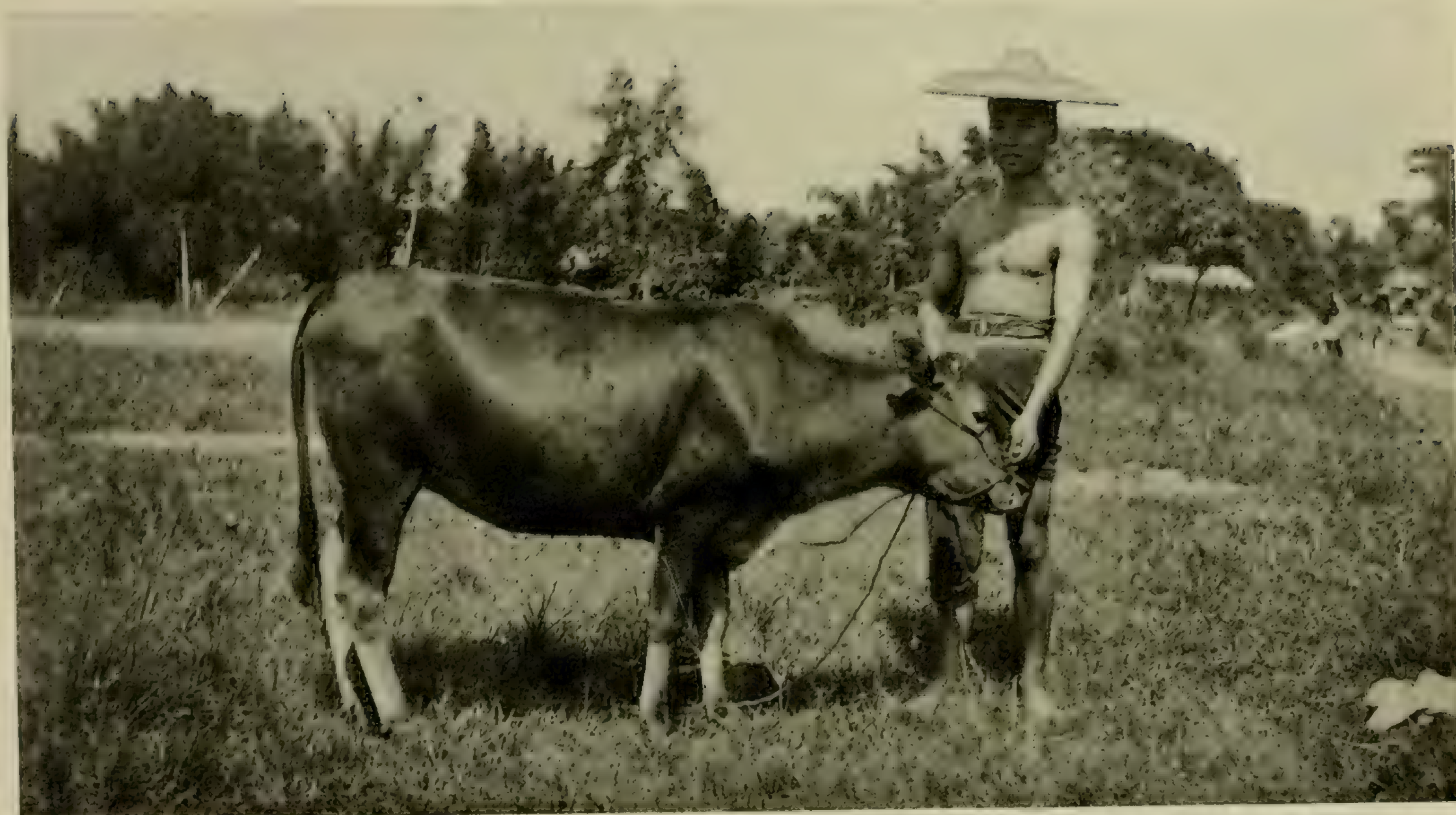
A NATIVE CHINESE BULL

The native cattle of China possess an enlargement or "hump" on the shoulders which is characteristic of cattle in the Orient. That is their main difference from European breeds. In bulls, the enlargement is sometimes ten inches above the level of the back, but in the females it is very much smaller. (Fig. 3.)

properly cared for they might give from 20 to 30 pounds of good wholesome milk.

STANDARDIZING MILK

Many dairies at present add water to the milk they sell in order to increase their profits. The danger of disease germs from the use of impure water is apparent, to say nothing of the unfairness to honest dairymen. Milk offered for sale should be analyzed for fat with a Babcock tester and a check be kept on watering milk. Buffalo milk containing less than 10 per cent fat and European cows' milk containing less than 3 per cent fat is undoubtedly watered milk. Dairymen found guilty of adding water should be heavily fined. Repetition of the offense should cancel the right of such a dairy to sell milk to the public. Buffalo milk should be sold for at least twice as much as foreign cow's milk, in order to remove the temptation to water such milk. It would, at such a price, be no higher in price for the food value it contains than foreign cow's milk, and based on per cent of fat, would be far cheaper. It is hoped that modern methods can soon be applied to the dairy and other animal industries of China, so that



A HEIFER OF THE NATIVE HUMPED SPECIES OF CHINESE CATTLE

In color and general markings these cattle resemble the Jerseys. The amount of milk yielded, however, is so small that cows are not often used for milking. The milk, however, has a high fat content, varying from 5 to 8 per cent. (Fig. 4.)

there will be a more efficient use of the country's wonderful resources.

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Were the Black-and-White Holsteins Originally Red-and-White?

There was recently born on the University of Idaho farm a pure-bred Holstein bull calf which was red-and-white in markings. This calf is the first calf of a heifer and it so happens that it is also inbred, that is, the sire of the calf is the sire of the dam. There is also evidence to the effect that this sire is the sire of another red-and-white calf out of a purebred Holstein cow, although this instance did not occur on the University of Idaho Farm.

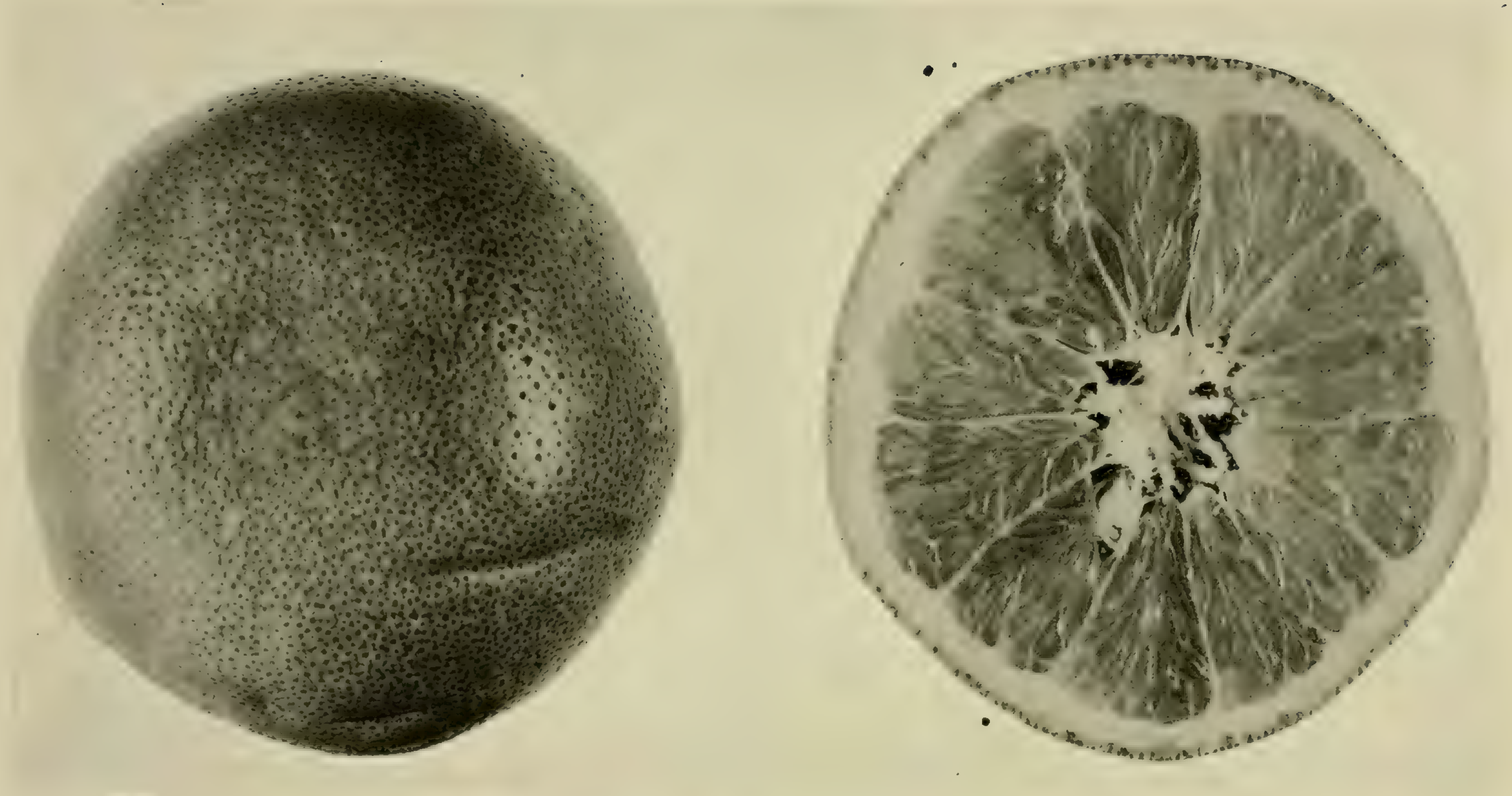
Instances have occurred of red-and-white calves having been dropped from pure-bred Holsteins in this country but, because they are ineligible to registry, usually no record is kept of them; in fact, breeders are likely to conceal the fact, thinking that it will be a criticism of their herd. There is evidence to believe that the Holstein-Friesians in Holland have been crossed with a red-and-white stock; in fact, the ancestors of the Holstein were very likely red-and-white.

We are interested in finding out as much data as we can regarding this inheritance of red-and-white color in Holsteins; consequently, we should be glad if any readers of the JOURNAL can enlighten us further with reference to the problem. We should particularly like to get in touch with anyone having a red-and-white heifer.—H. P. Davis, College of Agriculture, Moscow, Idaho.

Death of W. Schallmayer

In the death of Wilhelm Schallmayer, recently announced, Germany has lost one of her most eminent eugenists, a man who had devoted most of the active years of his life to spreading the application of genetics to human society.

In 1900 he published the first edition of his book, "Heredity and Selection," as a prize essay. The third edition, almost entirely rewritten, was issued in Jena in 1918.



A PINK-FLESH MARSH GRAPEFRUIT SPORT

Cross-section and blossom-end view. This fruit was taken from a limb of a Marsh tree in the L. V. W. Brown orchard near Riverside, Cal. "It was found that these pink-flesh fruits were borne by a single large branch in a typical Marsh grapefruit tree." The pink color was faint in the flesh, except near the rind, but conspicuous on the outside. (Fig. 5.)

ORIGIN OF A GRAPEFRUIT VARIETY HAVING PINK-COLORED FRUITS

A. D. Shamel
Riverside, California

AN INTERESTING illustration of the origin of citrus varieties from bud variations is found in the development of the Foster grapefruit. This variety was introduced by Reasoner Brothers of Oneco, Fla. As to its origin, Mr. E. M. Reasoner writes under the date of August 6, 1915: "This is a sport from the old-fashioned variety Walters. The Walters tree is growing in the Atwood grove near us, and the one limb that has pink-fleshed fruit is of good size, say 4 or 5 inches in diameter, and bears considerable fruit. About seven-eighths of the tree is Walters, the one limb only being Foster."

In their catalog for 1919 the Reasoner Brothers state in their description of this variety that it is identical with the Walters variety, from a tree of which it is a sport, except in the color of flesh. A description of the fruit is quoted from Governmental Pomological Notes as follows: "Next to the skin the flesh is a light purplish-pink color which shades to a clear translucent color at the core; there is very little pulp." In this same catalog Prof. Hume, the noted horticultural authority of Florida, is quoted as writing "my opinion of the Foster grapefruit is that it is a fine fruit. It is the best early grapefruit that I know of. It was in good eating condition at Winter Haven (Fla.) earlier than any other variety we have tested, and I think we have them nearly all."

The writer has not had the opportunity of studying this variety in Florida. He has observed young trees and fruits of this variety in Arizona in an orchard located near Phoenix during the month of December, 1918. The fruit from these trees, particularly the distribution of color in the flesh, resembled closely the above description of this condition in Florida grown fruits. The outside of the rind of the Foster grapefruit grown in Arizona, at the time they were examined, showed faint but unmistakable traces of pink color. In a comparison of the eating quality of this Foster fruit with that of other grapefruit varieties, including the Marsh, the writer's notes indicate that it was inferior and less desirable than that of the Marsh or the other varieties tested.

In Figs. 7 and 8, recent photographs are shown of Florida grown Foster grapefruit; these photographs were furnished to the writer by Mr. Walter T. Swingle. Some of the characteristics of these fruits and the leaves from a tree of this variety can be identified in these illustrations. Fig. 6 shows a typical Foster grapefruit tree.

The history of this variety furnishes another instance of the origin of a horticultural variety from a bud sport.

In July, 1919, the writer's attention was directed, by Mr. L. V. W. Brown, to a pink-flesh sport in a Marsh grapefruit tree near Riverside. It was found that these pink-flesh fruits were borne by a single large branch in a typical Marsh grapefruit tree. An inspection of the pink-flesh fruits borne by the same tree revealed the fact that, aside from the color of the flesh and the rind, the two fruits were as nearly identical as any two Marsh grapefruits usually are when taken from different branches of the same tree. This branch has been known to produce pink-flesh grapefruit for at least three years. Buds have been taken for propagation

A FLORIDA GROWN FOSTER GRAPEFRUIT TREE

This variety is a sport from the Walters variety and its fruit is identical with that of the latter except in the color of flesh, which is slightly pink near the skin. (Fig. 6.)

in an experimental way from this branch, but no trees grown from such buds have come into fruiting as yet. In this instance there was but faint trace of the pink color in the flesh anywhere except near the rind. On the outside of the rind the pink color was rather conspicuous, so much so, in fact, as to unmistakably mark the fruit. Fig. 5 shows a typical fruit of the California grown pink-flesh Marsh grapefruit sport.

Other instances of pink-flesh citrus fruit varieties originating from bud sports have been reported. Additional data concerning them is being collected as opportunity permits. The writer would appreciate any further facts concerning this phenomenon, for the purpose of completing the evidence as to the origin of other varieties of the citrus bearing pink-flesh, red, ruby or other strikingly different colored fruit from that of the established varieties bearing fruit possessing the normal color of flesh and rind.

TYPICAL FLORIDA GROWN FOSTER GRAPEFRUIT

Showing the shape of the fruit, texture of the rind, and other characteristics, together with the shape and other characteristics of the leaves from a Foster tree. (Fig. 7.)

CROSS-SECTION OF FLORIDA GROWN FOSTER GRAPEFRUIT

Showing the thickness of the rind, arrangements of seeds, and other characteristics. The pink color of the flesh, of course, does not appear in this photograph. (Fig. 8.)

SELF-FERTILIZED EARS OF MAIZE SHOWING DEFECTIVE SEEDS

The ratio of defective to normal seeds in each of the above ears is given in the Table on page 166. The ears labeled 110-12 and 110-17 are descended from the ears labeled 12 and 17 in Fig. 15. (Fig. 9.)

HERITABLE CHARACTERS OF MAIZE

IV. A LETHAL FACTOR—DEFECTIVE SEEDS

D. F. Jones

Connecticut Agricultural Experiment Station, New Haven.

LETHAL factors are familiar in corn in the form of several different kinds of chlorophyll deficiencies. White and virescent seedlings represent heritable characters which stop growth as soon as the food stored in the seed is exhausted. Golden plant color and many forms of striping permit growth and reproduction, but at a reduced rate.

A new factor, which shows itself in the form of aborted seeds with either entirely empty pericarps or badly shriveled seeds, has been found, being completely lethal in its action in some cases and partially so in others. Development of both the embryo and endosperm is stopped completely or greatly reduced shortly after fertilization. However, the fertilization process is sufficient to start the pericarp, and this developes unchecked to very nearly as full an extent as if the contents were present, although the empty hulls are greatly compressed by the crowding of the normal seeds adjacent. Fortunately the growth of the pericarps makes the distribution of the abnormal seeds easily apparent. The behavior of this character indicates that it is recessive and due to a single factor difference. This gene is called *defective seed* and is designated *de*.

OCCURRENCE OF DEFECTIVE SEEDS

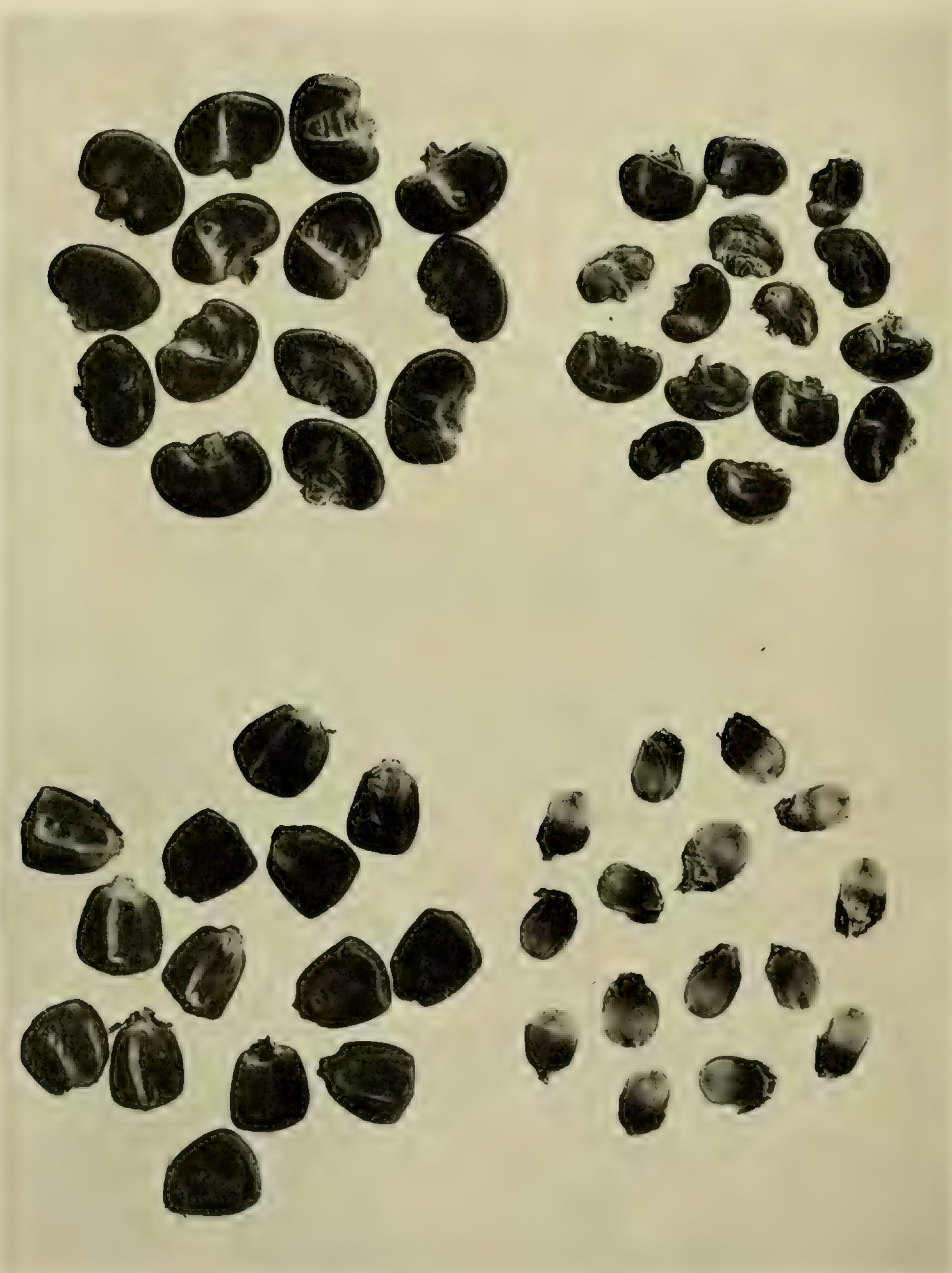
Attention was first called to this condition by some ears of corn grown on plants of ordinary field varieties which had been self-fertilized for the first time. A considerable number of plants of four varieties chosen as among the highest yielding sorts in this locality were raised. Two of these were dent and two flint varieties of rather distinct type and have been widely grown in the state.

Altogether about 75 selfed ears were obtained from the four varieties, and in three of these 8 ears were found which were definitely segregating into normal and defective seeds. After such a factor was once recognized it was noted in many other kinds of material from widely different sources. It has also been noted by others working with corn. It has been detected in several different types of popcorn, in sweet corn, and in locally grown varieties as well as in tropical sorts, so that unquestionably it is widely distributed and may occur in practically all kinds of corn. In field-pollinated plants cross-fertilization tends to keep the character hidden from sight. Chance recombination allows a few seeds to appear on plants heterozygous for the abnormality, but since a few abortive seeds are common on nearly every ear of corn, due to various causes, such seeds pass without particular notice.

When the plants are self-fertilized, then if the genetically defective seeds are present at all they appear in approximately 25 per cent of the seeds and, because of their greater numbers and distribution over the entire ear, they show up plainly. The character is manifested in several different degrees and it is not yet certain that they are all due to the same factor. This remains to be seen, but that there is a definitely inherited factor there can be no doubt. The difference between the recessive seeds and the normal seeds on the same ears is usually pronounced, and classification can be easily made.

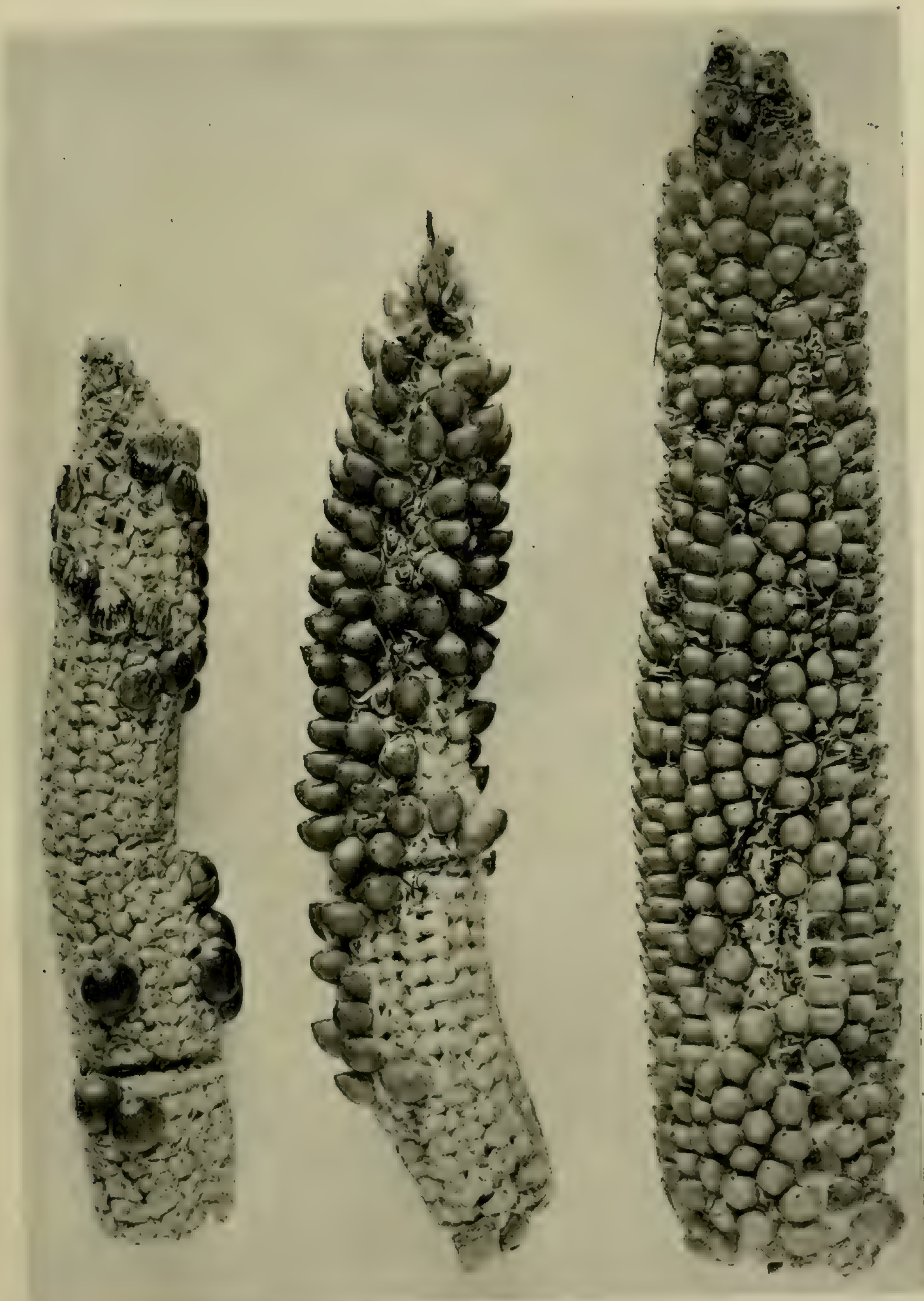
DESCRIPTION OF THE CHARACTER

In its extreme manifestation the pericarps develop but are completely empty. Such unfilled capsules are distinct from partially developed ovules due to incompleted growth or ineffective



NORMAL AND DEFECTIVE SEEDS COMPARED

The defective seeds (right) are from the same ears as the normal seeds (left). In the specimen shown at the bottom the pericarps of the defective seeds are nearly empty, as indicated by their transparency. In the specimen at the top the defective seeds are partially developed but badly shriveled and shrunken. (Fig. 10.)



THE RESULT OF INCOMPLETE POLLINATION

In the ear at the left, the undeveloped ovules are clearly different from the defective seeds on the other two ears. The middle specimen shows the result of both insufficient pollen and hereditary deficiency. Photograph by R. A. Emerson. (Fig. 11.)

DEFECTIVE SEEDS

Some completely aborted seeds with a few partially developed ones are shown. The empty shells, flattened between normal seeds, are not conspicuous until the latter are removed. Photograph by R. A. Emerson. (Fig. 12.)

fertilization (Fig. 11). Where the empty shells occur between normal seeds they are flattened to a thin sheet and are inconspicuous until the seeds are removed from the cob. Then the aborted seeds stand out plainly, scattered over the rachis, as shown in Figure 12. In other segregating ears (as in Fig. 13) the defective seeds contain some embryo and endosperm material. Such partially developed seeds are small and usually very much shriveled (Figs. 10 and 14). In other cases the seeds are not shriveled but are smaller and have a dull opaque appearance quite distinct from the transluscence of dent and flint seeds having corneous endosperm.

Where there is considerable material in the defective seeds they may germinate, but usually very poorly, and when they do, the seedlings are extremely weak, abnormal in appearance, and make a slow growth. In a few cases the seeds germinate well and the seedlings appear normal. Generally the seedlings are lacking in normal green chlorophyll color.

INHERITANCE OF DEFECTIVE SEEDS

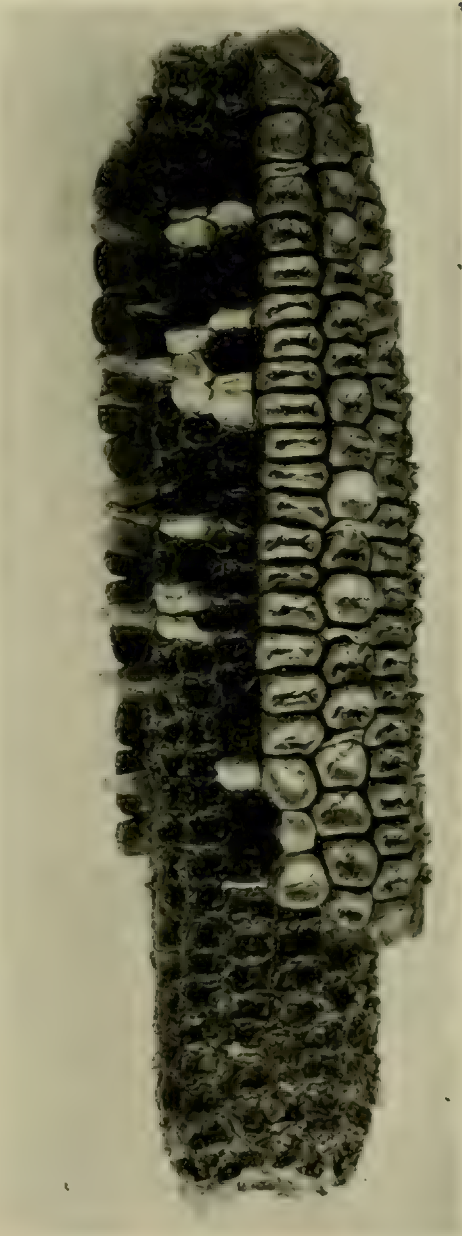
The normal seeds of the 8 segregating ears were planted and again self-fertilized. In every case the same condition appeared in some of the ears of the progeny, as shown in the Table. In addition, 5 ears which were not considered to be segregating also gave clearly segregating ears in the progeny. All the ears were examined for this character while they were being shelled off, but no defective seeds in sufficient amounts on these parent ears were seen to classify these five ears at that time as segregating. However, a photographic record of the original ears was made and this shows that three of the specimens were probably segregating. At least a few defective seeds can be seen, although the numbers are small. The remaining two ears show no signs of defective seeds and the ears are well developed, with about 500 seeds on each. Yet one clearly segregating ear was found in each of the two progenies in a total of five and six selfed ears in the two lots. This small number of segregating ears.

where they should occur in the ratio of two segregating plants to one normal, together with the fact that the parent ears were normal, indicates that a more complex situation may exist in this particular material.

The numbers obtained from all the ears together show the recessive seeds to be fewer than the expected numbers based on a single factor difference. A number of non-segregating ears in the same lots as the ears showing the defective seeds, as well as normal ears from unrelated sources, were examined, and from 1 to 5 per cent of partially developed seeds were found on many ears which might easily be included in the defective class. Therefore if the recessive seeds were in excess as much as 30 per cent instead of the expected 25, this would not be thought unusual. But the deficiency in numbers is clearly due to some influence. It may be that a certain proportion of recessives do not stimulate the pericarp to develop sufficiently, or the active competition on a crowded ear may prevent development enough so that all the defective seeds are included in the count.

In the original lots of self-fertilized ears the segregating individuals are generally smaller and more poorly developed than the normal ears. This may be evidence that the same factor which prevents normal growth in the seeds in the homozygous recessive condition also reduces the vigor of the plants when in the hybrid condition. Further investigation is necessary to establish this, but the material all together indicates that this is the case. The defective seeds which will germinate have not been tested long enough to determine whether or not they are capable of completing their growth and reproducing themselves.

In Fig. 15, which represents the original lot of selfed ears of one variety, specimen No. 12 shows partially defective seeds, while in the one numbered 17 the recessive seeds are completely aborted. The empty shells of the pericarps only remain. In Fig. 9 some of the progeny ears of these two plants



PARTIALLY DEFECTIVE SEEDS

Showing a few seeds completely aborted. The "partially developed seeds are small and usually very much shriveled." Photograph by R. A. Emerson. (Fig. 13.)

NORMAL AND DEFECTIVE SEEDS

These seeds are from two segregating ears and show the differences in size of the embryo. In this case the defective seeds "are not shriveled but have a dull opaque appearance." Seeds furnished by R. A. Emerson. (Fig. 14.)

TABLE SHOWING THE NUMBER OF NORMAL AND DEFECTIVE SEEDS PRODUCED BY THE PARENT PLANTS AND THE BEHAVIOR OF THEIR PROGENY.

Pedigree number of parent ear	Number of seeds		Number of progeny plants		Number of seeds of segregating progeny ears	
	Normal	Defective	Non-segregating	Segregating	Normal	Defective
40–12	185	35	4	2	242	47
40–13	187	64	3	4	567	120
40–17	117	30	4	4	429	147
105– 9	250	73	2	7	1243	407
105–14	all?	....	9	1	164	42
105–15	all?	....	1	2	387	129
110– 8	356	101	2	4	697	170
110–12	329	100	3	5	989	342
110–15	all?	....	5	3	731	138
110–17	142	44	2	2	475	171
110–18	153	71	2	4	510	138
112– 4	all?	....	5	1	421	146
112– 6	all?	....	4	1	288	90
Found	1719	518	46	40	7143	2087
Expected	1678	559	29	57	6922	2308
Deviation	+41	−41	+17	−17	+221	−221
Probable error	±13.8		±2.7		±28.1	

are shown, and it can be seen that the same grade of defectiveness in the parents is reproduced in the offspring. Whether this is due to other factors in the plant determining the degree of development of whether there exists an allelomorphic series remains to be worked out.

The character, defective seeds, is a useful one in studies of linkage relations in corn, as it is a seed character and easily classified in most cases. It is also of interest because it is an illustration of defective germ-plasm, which is widely distributed in a cross-fertilized organism and has vital importance in life processes.

ORIGINAL LOT OF SELF-FERTILIZED EARS

Original ears of the variety number 110 self-fertilized for the first time. Nos. 8, 12, 15, 17 and 18 are segregating for the defective seeds. "Specimen No. 12 shows partially defective seeds, while in the one numbered 17 the recessive seeds are completely aborted. . . . In Fig. 9 some of the progeny ears of these two plants are shown, and it can be seen that the same grade of defectiveness in the parents is reproduced in the offspring." (Fig. 15.)

THE FRANK N. MEYER MEMORIAL MEDAL

Designed by Theodore Spicer-Simon, and awarded to Barbour Lathrop as a recognition of his services in the work of introducing foreign plants of economic value into America. A white-barked pine cone and a fruiting branch of the Chinese jujube form the theme on one face of the medal and the First Plant Introduction Expedition that on the other. See the text for translation of the Chinese poem (618 A. D.) and details of the Theban Queen's expedition (1570 B. C.). (Fig. 16.)

FOREIGN PLANT INTRODUCTION MEDAL[1]

Memorial to the late Frank N. Meyer presented to Mr. Barbour Lathrop "for distinguished service in the field of Foreign Plant Introduction"

David Fairchild

President of the American Genetic Association

FRANK N. MEYER, Agricultural Explorer of the Office of Foreign Seed and Plant Introduction, who lost his life in the waters of the Yangtze River, left a bequest of a thousand dollars which was to be used by the staff of that office to defray the expenses of an outing or to be equally divided among them. This was Mr. Meyer's touching tribute to the organization with which he was connected for thirteen years as its agricultural explorer in China, Turkestan and other parts of Asia.

Rather than use the fund thus left by Mr. Meyer for the purpose which he designated in his will, the individuals of the Office preferred to put the bequest into a permanent tribute to his memory in the shape of a medal which should be awarded for distinctive service in the field of foreign plant introduction. This has been done, and the awarding of it one or more times a year it is hoped will not only do honor to those who deserve recognition for their services in this important field of research, but will arouse a wider and keener interest in what is surely one of the most important fields now open for young scientific men—that of the introduction into this country of new food and otherwise useful plants.

The medal, designed by the well known sculptor, Theodore Spicer-Simson, who designed the service medal given to Herbert Hoover by the National Academy of Sciences, has on one side of it a facsimile of the bas-relief which Queen Hatshepsut of the 18th Dynasty (1570 B. C.) had executed upon the wall of her palace at Thebes, to commemorate the first introduction of a foreign plant—the incense tree from the land of Punt. This is the first recorded monument we have to the work of Foreign Plant Introduction. On the reverse side of the medal is the name of Frank N. Meyer, for thirteen years Agricultural Explorer of the Office of Foreign Seed and Plant Introduction through whose bequest the medal is made possible. The Chinese inscription is from a poem by Chi K'ang, a poet of the Tang Dynasty, 618 A. D., which, freely translated, carries the thought that, "In the glorious luxuriance of the hundred plants he takes delight." To the right of this inscription is a fruiting branch of the Chinese tsao or jujube (*Ziziphus jujuba*), the cultivated forms of which constitute one of Mr. Meyer's contributions to the economic horticulture of America;

[1] The first of the Frank N. Meyer memorial medals for distinctive work in the field of plant introduction, which the associates of Mr. Meyer have had struck in his memory, was presented in the presence of the staff of the Office of Foreign Seed and Plant Introduction and invited guests to Mr. Barbour Lathrop of San Francisco on the 3rd day of May, 1920, in the Homer Building, Washington, D. C.

The associates of Mr. Meyer selected the American Genetic Association as the organization through which this memorial medal shall henceforth be awarded. The address of presentation by the President of the Association is printed in full as it gives the details regarding the meda and a brief account of the plant hunting expeditions of Mr. Lathrop whose work has contributed largely to the supply of plant species with which the plant breeders of America are now working in the production of superior forms of food and ornamental or other useful plants.—Editor.

on the left the white barked pine (*Pinus bungeana*), of which Mr. Meyer sent to America thousands of seeds which are now growing in many places in this country, and which in the centuries to come will add to our American landscapes one of the most picturesque of all evergreen trees.

AMERICAN GENETIC ASSOCIATION SELECTED AS TRUSTEE

Since there were certain objections to the awarding by a government office of medals of this character, the associates of Mr. Meyer have selected as their representative in the awarding of this medal the council of the American Genetic Association, an organization having in it as large a proportion of those interested in plant introduction as any organization in America.

In presenting this medal, therefore, I am acting as the representative of the American Genetic Association in the fulfillment of the trust imposed upon it by the associates of Mr. Meyer.

In this capacity I have the honor to announce this afternoon that there will be awarded this year three Frank N. Meyer medals, the first of which it gives me peculiar pleasure to present to my old friend, Mr. Barbour Lathrop, of San Francisco, who has come to be known in the Office of Foreign Seed and Plant Introduction as its "patron saint." I shall have to go back almost a quarter of a century in order to give you a clear idea of Mr. Lathrop's activities in the field of plant introduction which entitle him to receive this distinguished service medal.

BEGINNING OF FOREIGN PLANT INTRODUCTION AS A POLICY

On a small steamer off the coast of Malacca, as the ship's bell struck in the new year of 1897, Mr. Lathrop and I finished a conversation which started us both into the field of plant introduction. Mr. Lathrop's many years of almost continuous travel in foreign countries had impressed upon his mind the significant fact that every country has its own particular foods and that these have their own particular excellence. He saw that a scientific system of plant introduction would be of the greatest benefit to his country. Sitting there in the cabin of the steamer, he outlined his plans to me and convinced me that instead of continuing the researches which through his generosity, I was then occupied with on the fungus gardens of the termites, I should study the food and other useful plants of the countries he had planned to take me through as his guest. Through the following months which we spent in Siam, Australia and the South Sea Islands, the discussions on plant introduction continued, and when we reached Hawaii he investigated the possibilities of the establishment of a garden of plant introduction there but found them unsatisfactory.

Arriving in San Francisco, we parted, and I came on to Washington, where, with the constructive advice and assistance of my old friends Messrs. Swingle, True and Fernow and the willing cooperation of the then Secretary of Agriculture, Hon. James Wilson, whose convictions on the subject were as firm as were those of Mr. Lathrop, the first item was inserted in the appropriation bill which started the work of government plant introduction as a recognized policy.

STUDYING PLANTS IN THEIR OWN HABITAT NECESSARY

After a year of organization work, into the midst of which had been dropped the responsibility for the care of the Hansen collections in Russia, Mr. Lathrop again appeared upon the scene, and with logical arguments spread out over many nights, convinced me that I was no more fit to conduct a Section of Seed and Plant Introduction than a man who had never seen a chicken was fitted to run a chicken coop. His argument was that a world plant collecting service required in it the presence of some one who had seen the whole world, and he offered to take me over its surface in a rapid trip of reconnaissance. While his plan was convincing to me, it failed to convince Mr. Wilson, and it was with reluctance

that he let me go, and it was not until years later that he admitted in a complimentary letter to me that the plans had finally worked out well and that he was satisfied.

Leaving the office in charge of my friend Mr. O. F. Cook, who later was followed by Messrs. Jared Smith and A. J. Pieters, whose conduct of the office during trying times deserves the highest praise, we went through the West Indies, picking up an impression of the great value of the West Indian yam, the chayote, and the dasheen, all three of which are now promising cultures in this country. In Panama we picked up the Calamondine, established in Florida as a beautiful ornamental and one of the best stocks for the orange. From Chile we sent a thousand seeds of a hardy avocado, trees from which seed I had the pleasure of seeing in California last October.

SEARCHING THE WORLD FOR PLANTS OF ECONOMIC WORTH

We crossed the Andes into the Argentine and sent from the Chaco a spineless cactus which later was exploited by Luther Burbank; also seeds of the Maté or Paraguayan tea, which has since become established in South Florida.

Crossing to England, I first made the acquaintance, through Mr. Lathrop's friends, of the Windsor Broad bean—rival of our Lima bean, though not so well suited to our climate. We wandered through Europe to Egypt, stopping in Austria to get acquainted with the Hanna barley and to secure a new and valuable variety of horseradish.

In the Nile Delta the remarkable character of the Egyptian clover or Berseem attracted our attention, and our studies led to a second trip there later, and to a bulletin, which has been translated into Italian and has helped in the introduction of this plant into Tripoli and Tunis but not into America because of the lack of a climate sufficiently like that of Egypt to make it possible.

I can see Mr. Lathrop in my mind's eye today as we argued whether to send in a few seeds or a hundred pounds of seed of the valuable Egyptian cotton varieties. Mr. Lathrop prevailed, and we sent 100 pounds, out of which, through years of careful breeding and selection and wonderful team work, Messrs. Kearney, Cook, Swingle and Scofield have built up an industry for the farmers of Arizona worth to them $20,000,000 a year.

The Lebbek tree, which in honor of the Empress Eugenie and the opening of the Suez Canal was planted in a five-mile avenue to the great Pyramids. was written up and seeds were imported. It is now a landscape feature in parts of Florida.

Back again to the Dutch East Indies we traveled as far as New Guinea, sending collections of rices from Java, arranging for the sending of mango trees from Ceylon, eucalyptus trees from the Island of Timor—trees which are now sixty feet high and are scattering seeds over South Florida—and gathering information in regard to a host of plants which later were imported into America.

From the spice islands of Amboina and Banda, the coast of New Guinea, the Aru Islands, Ceram, Kisser and Letti, and the great mysterious Island of Celebes only a few things reached home alive, but a knowledge of that gigantic archipelago which stretches as far around the globe as New York is from San Francisco, served well to counterbalance the natural provincialism of my middle western education, which would make it appear that the agriculture of this globe is an agriculture of corn, wheat and hogs, and has made it possible to conduct the Office from a broader standpoint.

Turning back toward Europe, we made a quick run into India, and there saw for the first time the Brahmin cattle and the milch breeds of water buffalos. This glimpse enabled us to write an account which was published by Secretary Wilson, and was of assistance, I am informed, in attracting attention to Mr. Borden's remarkable experiments which led to the importation of the Brahmin stock into Texas and the resulting hybrid race of cattle

which has proven more resistant to drouth there than any other breed. The Philippine Islands are now importing, I am told, the milch breeds of the water buffalo which we discovered were of such value in British India.

Sent by Mr. Lathrop to Sweden and Finland to recuperate from an attack of typhoid picked up in Ceylon, I was able to bring to the attention of the department the remarkable seed-breeding establishment of Svalof and incidentally to establish the Finnish Black oat and the Finnish turnip in Alaska, both of which have, according to Mr. Georgeson, added greatly to the food production of that country.

GREAT WEALTH OF PLANT MATERIAL IN CHINA

We returned to America in 1900, and Mr. Lathrop again disappeared for a year from active service for the cause of plant introduction, returning in the autumn of 1901 with the proposal of an Oriental journey for the department, which was accepted, and which in returns exceeded any of the previous expeditions. It brought to the attention of the Office the great wealth of plant material in China and through the acquaintance made of Dr. Augustine Henry, the veteran plant student of that vast country, led ultimately to the exploration of it by our associate Frank N. Meyer, who spent nine years in its study. Our expedition resulted in the introduction of a collection of the East Indian and Cochin China mangos which are now fruiting as large trees in southern Florida, the first of the Persian Gulf date palms, from a single tree of which in southern California as much as seventy-five dollars' worth of fruit were sold this year by the owner. Mr. Lathrop sent me to the Persian Gulf while he made a trip to the east coast of Sumatra, where he secured a quantity of seed of the Sumatra wrapper tobacco in the face of the opposition of the Dutch planters there. The plants from these seeds entered into the hybrids which have made the Connecticut tobacco famous.

From the rich plant field of Japan was sent in a collection of twenty-nine varieties of the flowering cherries, and those who see the cherries on the Speedway in Washington, or the older collection at my place "In the Woods," or the collection in the Golden Gate Park in San Francisco, must thank Mr. Lathrop for the inspiration and encouragement which this collection gave to the widespread cultivation of these glorious trees in America.

GRASSES AND FRUITS SECURED IN AFRICA

Returning again to America in the summer of 1902, Mr. Lathrop and I started out in the autumn of the same year to make a hurried survey of the Dark Continent and sailed down its east coast, stopping at the German colony of Dar Es Salaam and the British colonies of Natal and the Cape. The Rhodes grass, seeds of which were given us by the manager of the Cecil Rhodes estate near Cape Town and which today has become an important hay crop in Florida, Texas and California, and the Carissa, finest of all evergreen hedge plants, which has now become an established thing in south Florida, were secured that year. The Spek-boom, a forage plant upon which the elephants feed, a remarkable small fruited pineapple from Natal, the Limoncella apple of Naples, the Kaffir orange and Kaffir plum of Natal and Cape Town and the Lathrop mango from the Island of Chiloane off the coast of Beira, have all become established in America as the result of this last expedition of Mr. Lathrop's, which ended in the summer of 1903.

Although since then Mr. Lathrop has conducted no long expeditions, his interest in the work of plant introduction has continued. During his travels he has sent us many valuable things, including a most complete account, with photographs, of the soy-bean products of Japan, and during his last trip to that country he sent us what is known there as the most popular vegetable of the Japanese people—the mitsuba—a plant which, although common in our own woods, has never been domesticated, so to speak, by Americans, although in Japan it is grown as extensively as celery is with us.

But of all the things about which Mr. Lathrop has been enthusiastic there is nothing to which he has devoted so much thought as to the subject of the introduction of the Japanese timber and edible bamboos—nothing about which he is more convinced than of its great future importance to America. A collection of eighteen selected varieties and a bulletin on bamboo culture resulted from the expedition in 1902. Later Mr. Lathrop has added a kit of Japanese tools, a collection of baskets and valuable Japanese books on bamboo culture. During the past year he has crowned his work by the gift of a bamboo grove. This gift comprises 46 acres of land near Savannah, Ga., on which is three-quarters of an acre of magnificent bamboo 50 to 60 feet tall, planted years ago by Mrs. H. J. Miller, with plants introduced by Andrias Maynelo, of Savannah. This grove is to constitute the center for the propagation and study of this most important crop for the southern states.

MR. LATHROP'S VALUABLE SERVICES

This is a meager account of the volunteer services which Mr. Lathrop has given for a quarter of a century at his own expense. The valuable advice and the moral support which he gave when they were needed the most and the assistance which he has given to the establishment of so many valuable new industries in our country merit a recognition which his own modesty has made it heretofore impossible to give him, and it is therefore with peculiar pleasure that I who owe so much to him personally as well as officially, present to him in the form of the Frank N. Meyer medal the recognition which I know all of us of the Bureau of Plant Industry who are associated with the work of introducing new plants feel he so justly deserves.

Mr. Lathrop, I present to you the first Meyer memorial medal.

WITH COMMISSIONER CAPERON IN JAPAN

Mr. Lathrop's remarks, upon receiving the medal, carried the audience back half a century to the early days in Japan, when, as a young man visiting there, he met the former United States Commissioner of Agriculture, Mr. Caperon, who had been invited by the Japanese to come over and assist in the organization of Japanese agriculture.

The speech was extemporaneous and it was not Mr. Lathrop's wish that it be published.

LETTER OF PRESENTATION

May 3, 1920.

Barbour Lathrop, Esq.,
Bohemian Club,
San Francisco, Cal.

Sir:

The Council of the American Genetic Association has been designated by the members of the force of the Office of Foreign Seed and Plant Introduction of the Bureau of Plant Industry of the United States Department of Agriculture as the agency through which shall be presented the Frank N. Meyer medal for distinctive service in the field of foreign plant introduction.

Your broad, constructive interest in the subject of plant introduction in the days of its inception in this country; your various expeditions to South America, South Africa, the Dutch East Indies, Japan, China, the Persian Gulf region, Australia, Siam, the South Sea Islands, and the principal countries of Europe and the Mediterranean region in search of new and valuable plants, which not only put the office in touch with the plant collectors of the world, but which assisted most materially in the ultimate establishment in America of the Persian Gulf dates, the Egyptian cotton, the Rhodes grass, the East Indian mangos, the Oriental timber bamboos, the Japanese vegetables Udo and Mitsuba, and many other varieties of plants; your recent gift to the government of an important field station—the Savannah Bamboo Grove—entitle you, in the opinion of the council, to be the first recipient of the Frank N. Meyer medal.

It is with pleasure, therefore, that the council unanimously awards you this medal.

COTTON A COMMUNITY CROP

One-Variety Communities Must be Recognized as the Basis of Production, in Order to Preserve and Utilize Superior Varieties of Cotton

O. F. Cook

Bureau of Plant Industry, U. S. Department of Agriculture

ORGANIZATION may be desirable with any crop, but cotton has a special community feature, the product of many farms going to the same gin. The cotton industry should have been placed on a community basis when public gins supplanted the former system of private or plantation gins, but methods changed gradually and consequences were not considered. Ginning is done with less labor by the modern high-power equipment, but the public gin system has made it very difficult to keep seed pure, or to have superior varieties in general cultivation.

CONSEQUENCES OF THE PUBLIC GIN SYSTEM

Improvement of varieties was more feasible under the old system of private gins because the careful planter could maintain uniform strains of cotton, by selecting the best individual plants, isolating their progenies, keeping the seed separate, and furnishing pure seed to stock other plantations, as the custom was. Present-day farmers very seldom practice individual plant selection, or maintain stocks of pure seed. Different kinds of cotton are grown in the same communities, the seed is mixed at the public gins, crossing takes place in the fields, and degeneration ensues.

According to the general testimony of the cotton trade there has been a serious deterioration in the quality of the American cotton crop in recent decades, which can be understood when account is taken of the effects of mixing and crossing different varieties, and the general use of ordinary "gin-run" seed for planting. The system of plantation gins survived longer in the Sea Island districts of the Southeastern States and the lower Mississippi Valley, so that the long-staple branch of the industry remained on a somewhat better footing until recent years. But with the boll-weevil invasion the dominance of short staple varieties and of the public gin system became complete.

Though it would be considered foolish for a large grower having a private gin to plant several varieties and allow them to become mixed, this is essentially the procedure that is followed by members of cotton-growing communities. It is true that communities seldom own gins, but gins are supported by communities, and ginners as well as farmers would profit through improvement in yield, quality and market value of the crop. Better ginning could be done, and with less difficulty, if only one variety were handled, instead of many kinds.

DETERIORATION OF VARIETIES THROUGH CROSSING

The idea formerly entertained, that cotton is not cross-pollinated, or that crossing is very infrequent and not of practical importance in relation to seed-supplies, has proved to be erroneous. Cotton pollen is not blown by the wind, because the grains are sticky and adherent, but is carried regularly by bees or other insects that visit the flowers, so that varieties growing in neighboring fields are cross-pollinated, in addition to the general crossing that takes place in fields where mixed seed is planted. No matter how good the original varieties may have been, a mixed stock becomes, in a few generations, thoroughly miscellaneous and mongrelized, with many abnormal and infertile plants, very inferior to the parental types.

The degeneration that results from crossing no doubt is the basis of the

popular idea that cotton varieties "run out" in a few years, and that "fresh seed" must be brought in from other districts. But the fact is that locally selected seed of good varieties has proved better than imported seed, when careful comparisons have been made. Moreover, some of the best known varieties have been grown continuously in the same districts for many years, with no indication of "running out," as long as isolation and selection are maintained.

A system like ours, that mixes different varieties together and uses inferior, mongrel seed as the basis of production, no doubt would be considered very backward if discovered in a foreign country. Chinese farmers might be excused on the ground of having no select varieties to plant, whereas American farmers, although they have had superior varieties developed, have not learned how to maintain and utilize pure stocks of seed. In this respect our system must be considered defective and wasteful, not only to the farmer and the manufacturer, but to all who use cotton for any purpose that requires strong or durable fabrics.

EXTENT OF PURE SEED REQUIREMENTS

Full utilization of superior varieties is possible only in one-variety communities, since it is only in such communities that select, uniform stocks can be maintained and increased. The varieties are not fully utilized unless they serve as the basis of crop production over large areas, and for many years. Utilization does not begin until a variety is represented by enough pure seed to plant a field of cotton, and the requirement of pure seed is still the same when the culture of the variety extends over millions of acres. It is not sufficient that an improved variety be adopted by many individual farmers scattered in mixed communities, because this does not provide an adequate and continued supply of pure seed.

There is no prospect of centralizing the production of cotton seed in a few communities or districts for supplying the entire industry. A vast quantity of seed, more than 500,000 tons, is needed for planting the American cotton crop, whereas only about 30,000 tons are handled by seed-dealers. On account of the relatively large size of the seeds, the limited number produced on a plant, the need of heavy seeding, and the holding of reserves for replanting, about ten per cent of the entire crop must be of planting quality to afford a general provision of good seed. The cost of transporting the entire volume of seed would be enormous, in addition to the danger to the whole industry through distributing insect pests or plant diseases, or through failures of crops in seed-supply districts.

THE SOCIAL FACTOR IN UTILIZATION OF VARIETIES

If the utilization of varieties depended upon finding a new chemical to treat the seed or to fertilize the soil, or upon devising a new machine for planting, cultivating or harvesting the crop, the problem would appear normal, and a solution could be sought along the usual technical lines, but social factors enter the reckoning when it is understood that *superior varieties of cotton can be utilized only as they are preserved in one-variety communities.* Except through community action there seems to be no approach to a general application of the science of heredity or the art of plant-breeding in the improvement of the cotton industry.

That pure seed problems should be considered by sociologists is as little to be expected as that plant breeders should study community organization, but a common ground is reached when the practical needs are recognized. Breeders should value community cooperation, while sociologists and economists, as well as teachers and agricultural leaders generally, should take more account of the biological factors that determine the improvement or degeneration of varieties. To devise effective methods of organizing and conducting the activities of one-variety communities, in growing, handling and marketing the crop, and in maintaining the purity and uniformity of the basic stocks, are problems of as much practical importance as the original dis-

covery or breeding of the varieties, and equally worthy of careful, scientific study.

The problems of cooperation are the field of research that needs most to be cultivated at the present time, for the general welfare of the cotton industry. The technical problems, the breeding of superior varieties, and the spinning and weaving of cotton by machinery, are much farther advanced than the general commercial problems of handling, transporting and distributing, which react directly upon production. On account of the present scarcity and acute demand for good fiber, the manufacturing and commercial interests are recognizing the need of research, but without understanding that improved systems of buying and handling the crop are as necessary as improved varieties. Not only facts regarding varieties and textile qualities of different kinds of fiber, need to be investigated, but the whole field of activities that lies between the breeding of varieties and the manufacturing processes.

ENORMOUS WASTE OF PRESENT SYSTEM

The damage to the industry that results every year from the lack of good seed and the resulting failure to utilize fully the resources of production must be estimated in the hundreds of millions of dollars. Replacement of our present inferior, mixed stocks by superior, uniform varieties would give a direct gain of at least ten per cent in quality, and as much more in yield, while another ten per cent might be expected from the cultural improvements that become possible in one-variety communities. Advantages from community handling and marketing of a standardized product would not be less important than the other items, and pure seed can be sold above the oil-mill prices. In returns to the farmer, our present unorganized production may have only a fifty per cent efficiency as compared with what may be found possible in well organized one-variety communities. The general waste of labor and resources of production in the eastern cotton belt contrasts painfully with the one-variety communities of the Salt River Valley of Arizona where the Pima variety of Egyptian cotton is grown exclusively, and the advantages of community organization are beginning to be realized.

ONE-VARIETY COMMUNITIES MORE PROGRESSIVE

Cultural problems are simplified in one-variety communities. Effects of different conditions of soils, seasons, and cultural methods are learned, instead of being confused with differences in the characters of the varieties. The most rapid progress in cotton culture is now being made in the Salt River Valley of Arizona, where only the Pima variety is grown. Cotton problems are discussed with interest and profit at farmers' meetings because everybody has had experience with the same variety of cotton. Such progress is not possible in communities where different kinds of cotton are planted and farmers ascribe their success or failure to the seed.

With adequate understanding of the behavior of one variety, methods are adjusted more closely to differences of soil, season and time of planting, and labor is applied to the best advantage in farm operations, preparing the land, planting the seed, thinning and spacing of the plants in the rows, cultivating, irrigating, harvesting and handling the crop. In weevil-infested regions it is especially important that all the farmers of a community grow the same variety, plant as nearly as possible at the same time, handle the crop together, and clear the fields early in the fall. One-variety communities develop skill, while mixed communities suffer from backward cultural methods as well as from deterioration of varieties.

MARKETING A STANDARDIZED PRODUCT

The final advantage of one-variety communities is in marketing the crop. In an unorganized community the farmer who raises better cotton than his neighbors usually is forced to sell it at the same price to the local buyer. The manufacturer pays more for the high-quality fiber, but the difference is absorbed by the buying trade, instead

of being shared with the farmer. The more valuable bales contribute to the profit of buying and sorting over the miscellaneous "hog-round lots" accumulated by local buyers, many of whom do not know how to "class" the cotton.

Failure to give the farmer practical encouragement in his effort to improve the crop is a serious defect of the present commercial system, but organized communities have a standardized product, better than any of the "even-running lots" that can be made by sorting and matching the inferior fiber of mixed communities so that the commercial problems are simplified. Even in advance of formal organization of communities, a distinct advantage may be shown as the one-variety condition is approached. The general popularity of the big-boll type of cotton in Texas has kept the crop more uniform and given that State an appreciable market advantage in comparison with other parts of the cotton belt. Premiums of $10 to $20 per bale, are being paid in Texas and Oklahoma communities because so many of the farmers grow the Lone Star or Acala varieties that buyers compete for the superior fiber. Active campaigns for commuhity standardization and marketing are in progress in Texas, Oklahoma and North Carolina.[1]

COMMUNITY CHOICE OF ONE VARIETY

No doubt it will be difficult and sometimes impossible to get farmers to agree upon one variety as the best for their community, though too much may be made of this obstacle. Even a poor variety will give better results with community handling than good varieties mixed together. An organized community can change promptly to a superior variety when a definite advantage can be shown. The Pima variety was substituted for the Yuma in the Salt River Valley in one season, after a sufficient stock of seed had been raised. Choice of varieties also is limited at present by the fact that stocks of pure seed are obtainable for only a few kinds. The first one-variety communities in each district will profit especially by selling seed to other communities. Pure seed sells as readily in carload lots as in bushels or tons. Community organization in the Salt River Valley has made possible a rapid extension of Pima cotton because a larger supply of pure seed is available than with any other variety.

EGYPTIAN COTTON COMMUNITIES IN ARIZONA.

It is appreciated in Arizona that the Pima cotton crop of the Salt River Valley communities in 1919 returned about $20,000,000 or nearly twice the cost of the Salt River reclamation project, including the Roosevelt dam, electric power-plants, and irrigation canals. The value of land suited to cotton has doubled or trebled in the last few years, some of it selling at $500 per acre. With reduced production in Egypt and loss of the Sea Island crop through the boll-weevil, the automobile tire industry becomes acutely dependent upon the Pima cotton raised by the Southwestern communities. In the spring of 1920 manufacturers are offering to guarantee a minimum price of 60 cents per pound, or to make contracts at 80 cents a pound, so that a very rapid extension of Pima cotton may be expected, not only in the Salt River Valley, but in the Yuma, Imperial, Coachella and San Joaquin Valley.[2]

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[1]Winters, R. Y., 1919, Community Cotton Improvement in North Carolina, *Journal of the American Society of Agronomy*, 2:121.

[2]See U. S. Dept. Agric. Bul. 533, "Extension of Cotton Production in California," and Bul. 332, "Community Production of Egyptian Cotton in the United States." The community plan in relation to cotton production was outlined in the Yearbook of the U. S. Dept. of Agric. for 1911, pages 397–410, under the title "Cotton Improvement on a Community Basis." Other papers that discuss community features are U. S. Dept. Agric. Bul. 60, "Relation of Cotton Buying to Cotton Growing," U. S. Dept. Agric. Bul. 288, "Custom Ginning as a Factor in Cotton Seed Deterioration," U. S. Dept. Agric. Bul. 324, "Community Production of Durango Cotton in the Imperial Valley," U. S. Dept. Agric. Bul. 742, "Production of American Egyptian Cotton," and Bureau of Plant Industry Circulars "Cotton Selection on the Farm by the Characters of the Stalks, Leaves and Bolls" and "Tests of Pima Egyptian Cotton in the Salt River Valley, Arizona."

FRUIT CLUSTER OF THE CUMBERLAND BLACK RASPBERRY

This is a variety belonging to the species *Rubus occidentalis*. The black raspberries under cultivation are natives of North and South America though other species occur in Asia. (P 922.) (Fig. 17.)

ARE OUR RASPBERRIES DERIVED FROM AMERICAN OR EUROPEAN SPECIES?

GEO. M. DARROW
Bureau of Plant Industry, U. S. Department of Agriculture

IT HAS been the common supposition of pomologists that most of our cultivated red raspberries are derived from American species. Varieties from the European species have been considered very susceptible to winter injury while those from the American species have been considered very hardy. Because varieties of red raspberries commonly grown in this country have been moderately hardy they were, therefore, thought to be derived from the American species.

A brief review of the points of difference between the two species of red raspberries which are the parents of our cultivated varieties will show how erroneous this view is.

Rydberg[1] gives the following distinctions between the European and American species:

Foche[3] makes but one species of both, classing *R. strigosus* as a variety of *R. idaeus*. His distinctions between the two, however, are similar to those of Rydberg, but he emphasizes the fact that while the upper part of the mature plants of *R. strigosus* is densely, rarely sparsely bristly, the upper part of *R. idaeus* is without bristles.

An examination of *Rubus idaeus* grown in this country under garden conditions show that these distinctions are apparently correct. As Rydberg states, the plants are not glandular-hispid, the stems, peduncles, and sepals are tomentose, the fruit is dark red and thimble shaped. As Card states, the canes are stouter, and less free in habit of growth. The prickles are firm, recurved, and less numerous than the bristles of *R. strigosus*. Some

EUROPEAN SPECIES *Rubus idaeus*	AMERICAN SPECIES *Rubus strigosus*
(1) Plant not at all glandular—hispid....	Plant glandular—hispid, especially in the inflorescence.
(2) Stems finely tomentose when young..	Stems not tomentose.
(3) Peduncles and sepals tomentose......	Peduncles not tomentose, sepals slightly tomentose.
(4) Fruit red..........................	Fruit light-red.
(5) Fruit thimble shaped...............	Fruit hemispherical.

Card[2] states that *Rubus idaeus* "is stouter and less free in its habit of growth, the leaves are a little whiter beneath, thicker, and generally somewhat wrinkled and the canes are light colored, bearing purple prickles in some varieties. The prickles on the finer parts are firmer, recurved, and less numerous." He also states *R. idaeus* bears more or less throughout the summer and that it is susceptible to winter injury.

of the plants bear in the autumn, though it may be that in the more humid climate of northern Europe they would bear still more in autumn. They are more susceptible also to winter injury than *R. strigosus*. As Focke states, no bristles appear on the upper part of the mature plants of *R. idaeus*.

Examinations of the cultivated varieties of raspberries known to have been introduced from Europe confirm this. (See Fig. 20.) Their fruit is of

[1] *North America Flora*, Vol. 22, Part 5.
[2] F. W. Card, "Bush Fruits," p. 167.
[3] "Species Ruborum," W. C. Focke, p 209.

TABLE I.—*Horticultural Varieties of Rubus Strigosus*

	Variety	Origin	Hairs on peduncles	Tomentum	Leaves
1	Crystal White...	New York....	Very glandular....	....	
2	Miller..........	Delaware.....	Very glandular....	None......	Medium thick.
3	Ohta...........	So. Dakota...	Very glandular....	None......	Thin.
*4	Perfection......	New York....	Very glandular....	Slight......	Thin.
5	Rancocas.......	New Jersey...	Very glandular ...	None......	Medium thick.
6	Royal Church...	Ohio.........	Very glandular....	Slight......	
7	Scarlet Gem....	Kansas.......	Very glandular....	None......	
8	Superb.........	New Jersey...	Very glandular....	None......	
9	Thwack........	New York....	Very glandular ...	None......	
10	Turner.........	Illinois.......	Very glandular....	None......	Thin.

TABLE II.—*Horticultural Varieties of Rubus Strigosus Which May Have a Trace of Rubus Occidentalis in Their Parentage*

	Variety	Origin	Hairs on peduncles	Tomentum	Prickles
1	Early Prolific...	Kansas.......	Glandular........	None......	Slightly recurved.
2	Eaton (Idaho)...	Indiana......	Glandular........	None......	Slightly recurved.
*3	King...........	....	Glandular........	None......	Recurved.
*4	Minnesota No. 4.	Minnesota ..	Glandular	Slight	Recurved (King × Loudon).
5	Minnetonka....	Minnesota....	Glandular........	None......	Recurved.
*6	Ranere(St.Regis)	New Jersey...	Glandular........	None......	Recurved.
*7	Sunbeam.......	South Dakota	Glandular........	None......	Recurved(Wild red × Shaffer).

a crimson color and not at all the light red of our common wild red raspberry. These varieties have been uniformly susceptible to winter injury. Two varieties only of all those known to have been introduced from Europe are raised to any extent—the Antwerp and the Superlative—both of which are grown in the mild climate of the Pacific Coast while only one other variety of *R. idaeus,* the Surprise of southern California, is raised commercially.

When our other red raspberry varieties are examined they show marked differences in regard to the characters distinguishing the two species. For example, the King is very glandular-hispid especially on the peduncles and sepals; the stems and peduncles are slightly or not at all tomentose; the sepals moderately so; and the fruit is bright red and hemispherical. On the other hand, the Cuthbert is rarely glandular-hispid, is somewhat tomentose, and the berry is crimson and thimble shaped.

The King seems to be a garden variety of *Rubus strigosus.* When we examine the Cuthbert critically it does not seem to belong wholly to either species. On two occasions when plants of this variety were found producing autumn fruit, scattered glandular hairs were found on the pendunucles and sepals. Otherwise they seem to be lacking. The stems, peduncles and sepals are more tomentose than *R. strigosus* though not as tomentose as *R. idaeus* while the fruit is thimble shaped and turns a dark red like that of the latter species. It seems to be a hybrid between the two species and this determination is supported by the account of its origin given by Roe,[4] "This is a chance seedling, which the late Thomas Cuthbert found in his garden at Riverdale, N. Y. His son has kindly furnished the following facts: "The

[4] E. P. Roe, "Success with Small Fruits," p. 16.

RED RASPBERRY FLOWERS

At the left in the upper row is shown a bud starting to open. In breeding, emasculation should be done just before this stage as the tips of the pistils show through sepals and might receive pollen from other flowers. At the left in the lower row the calyx has opened and the ends of the pistils may be seen in the center. Below at the right the petals are opening but no anthers have opened. Above at the right the petals have dropped and the anthers are shedding pollen. Because the stigmas are receptive long before the anthers open, cross-pollination is very common in the raspberries. (Fig. 18.)

raspberry in question was discovered by my father about eleven years ago (1865) in the garden of our county seat at Riverdale-On-the-Hudson. It is probably a seedling of the Hudson River Antwerp, as it was found growing near the edge of a patch of that variety, but its great vigor of growth and the size and quality of the fruit marked it at once as a new and distinct kind." Roe further states that though the Hudson River Antwerp is distinct from the Antwerp of England, "Mr. Downing says that its origin is known and that it was brought to this country by the late Mr. Briggs of Poughkeepsie, N. Y." It is therefore an European variety.

Thus it seems likely that the Cuthbert is a hybrid between *R. idaeus* and

FRUIT CLUSTER OF THE COLUMBIAN PURPLE RASPBERRY

This variety is supposed to be a hybrid between the Cuthbert red raspberry and the Gregg black raspberry and is therefore a combination of the species *Rubus* (*Idaeus x strigosus*) *x occidentalis.* (Fig. 19.)

R. strigosus. The King is evidently a variety of *R. strigosus,* while Antwerp, Superlative, and Surprise are varieties of *R. idaeus* introduced from Europe.

In the following tables the derivation of the varieties of our red raspberries is given as far as it is possible to do so at this time. The method used to determine their origin has been:

TABLE III.—*Horticultural Varieties of Rubus Idaeus*

	Variety	Origin	Tomentum	Leaves
*1	Antwerp	European	Dense	Thick.
2	Buckeye	Ohio (?)	Dense	Medium to thick, fall fruit.
3	Eastern King	Maine	Dense	
4	Fillbasket	European	Dense	Thick.
5	Franconia	European	Dense	Thick.
6	Hiram	New York	Dense	
7	Ohio Everbearing		Dense	
8	Perfection of Wisconsin	Wisconsin	Dense	
9	Red Merville	European	Dense	Thick.
10	La France (Cobb)	European	Dense	Thick, fall fruit.
11	Segrist	Kansas	None	Thick.
12	Sonchetti	European	Dense	Thick.
*13	Superlative	European	Dense	Thick.
*14	Surprise		Dense	Medium to thick.
15	Syracuse	New York (?)	Dense	Thick.
16	Wisbeck Perfection	European	Dense	Thick.

FRUIT CLUSTER OF THE BUCKEYE RED RASPBERRY

A variety belonging to the European species *Rubus idaeus.* (P 21063) Note that the berries are thimble-shaped, not hemispherical like the berries of the species *Rubus strigosus.* (Fig. 20.)

TABLE IV.—*Horticultural Varieties of Rubus Idaeus × Strigosus.*

	Variety	Origin	Hairs on peduncles	Tomentum	Prickles
1	Crimson Beauty	Kansas........	Not glandular.....	None.....	Long.
*2	Cuthbert.......	New York.....	Very few glands...	Fine......	Recurved.
*3	Empire........	New York.....	Not glandular.....	Fine......	(Ruby × Coutant)
4	Erskine (Park)..	Massachusetts.	Not glandular.....	Fine......	
*5	Golden Queen ..	New Jersey....	Very few glands....	Fine......	Recurved.
6	Hansell........	New Jersey....	Very few glands....	Slight.....	Recurved.
*7	Herbert........	Canada........	No glands........	Fine......	Recurved.
*8	June...........	New York.....	No glands........	None.....	(Loudon × Marlboro).
*9	Marlboro.......	New York.....	Very few glands...	Fine......	(Highland Hardy × Seedling).

TABLE V.—*Horticultural Varieties of Rubus Idaeus × Occidentalis*

	Variety	Origin	Tomentum	Leaves
1	Abundance....................	Michigan...........	Fine.......	Medium to thick.
*2	Royal.......................	Indiana	Fine	Thick.
3	Shaffer......................	New York..........	Fine.......	Thick.

First, an inspection of herbarium material supplemented where possible by observations of the varieties in the field.

Second, a study of the history of the variety.

While this method will be found satisfactory in determining the origin of most varieties, it cannot be accepted as final for some sorts. The more accurate methods of the plant breeder must be used to settle the origin of doubtful ones. Hybrids between varieties representing both species must be made; doubtful varieties must be selfed, and at least an F_1 generation grown. For example, only the results of breeding work can determine just how the character of glandular hairs is inherited. On most of the varieties classed below as *Rubus idaeus* × *strigosus* hybrids, few or no glandular hairs are present, yet in hybrids between *R. occidentalis* and *R. strigosus* glandular hairs are abundant; also in blackberry hybrids between a species having glandular hairs and one without them, the F_1 plants seem intermediate in this respect. It may be that many varieties are hybrids between *R. idaeus* × *strigosus* crossed back on *R. idaeus* or *R. strigosus*. Such hybrids may show but slight traces of one parent.

It is easy to note from the appearance of fruit stems of typical members of each of the species and hybrids between the species, that the contrast between varieties belonging to the European and the American red raspberry species is very marked.

The prominent commercial varieties have been marked with an asterisk (*) Of these it will be seen that five varieties (including those in Tables 1 and 2) belong to *Rubus strigosus*, three to *Rubus idaeus*, six to *Rubus idaeus* × *strigosus*, one to *Rubus ideaus* × *occidentalis*, one to *Rubus* (*idaeus* × *occidentalis*) × *strigosus* and one to *Rubus* (*idaeus* × *strigosus*) × *occidentalis*. The black raspberries have not been listed, as there seems to be no reason to think that any of them are not horticultural varieties of *Rubus occidentalis*.

Certain questions will at once suggest themselves to breeders and pomologists such as:

1. Do the commercial varieties given in Table 2 actually have *Rubus occidentalis* in their parentage? These varieties are known to be hardier than any commercial raspberries in the other groups except those in Table 1 and perhaps Herbert in the group of varieties derived from *R. Idaeus* × *strigosus*.

2. Should not varieties listed in Table 2 be used in breeding sorts for sections with severe climates?

3. All our purple raspberries seem to have *Rubus Idaeus* as one of the parents. Should not hardy varieties of *Rubus strigosus* be used as one parent in future breeding work and a hardy variety of *Rubus occidentalis*, such as Older, be used as the other parent?

4. Why not try other European varieties in the milder parts of the Pacific Coast States as the varieties now grown there are largely introduced from Europe? The Royal Horticultural Society of England recommended in their "Selected List of Hardy Fruits" the Devon, Wisbech Perfection, Baumforth, Hornet, and for autumn fruiting, Alexandra, and Surprise d' Automne. In addition Abundance, Bountiful, Norwich, Profusion, and Semper Fidelis (liked for jam making) might be tested.

ILLUSTRATING THE STRUCTURE AND MATHEMATICS OF THE HUMAN GERM-PLASM

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An ABACUS is a very simple piece of apparatus, while the germ-plasm is very complex. Still it is possible by such an apparatus to illustrate the basic geography of the chromosome, and also to demonstrate the elementary mathematical principles involved in the segregation and recombination of genes.

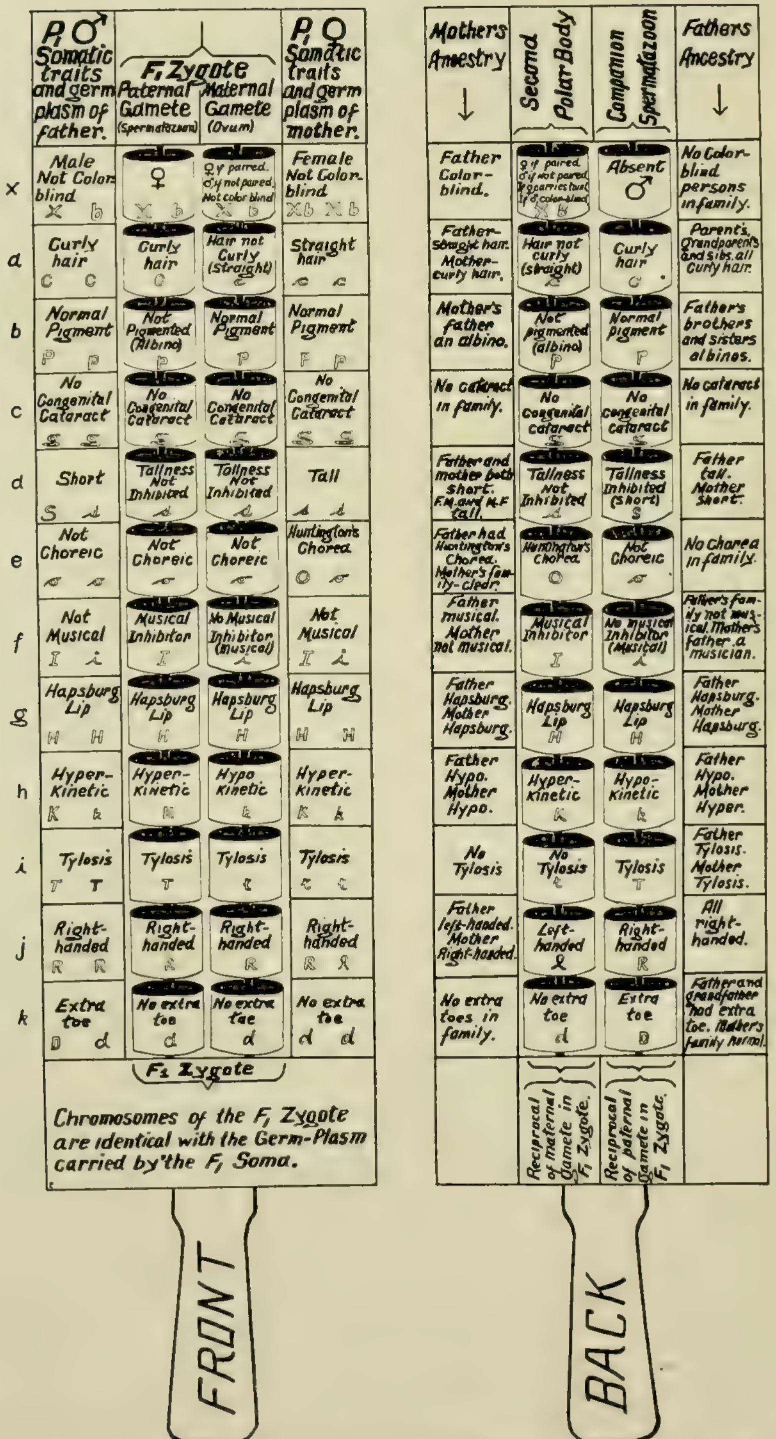
The germ-plasm abacus consists essentially in two rows of spools so arranged that each spool has a definite and homologous companion. There should be as many spools in each string as there are chromosomes in the gametes of the particular species which the apparatus demonstrates. Until more is known in the case of man concerning the shapes and relative lengths of the individual chromosomes, it will not serve any useful purpose to differentiate spool-shapes in this simple apparatus. Later it may be possible to make each spool a model in shape and relative size of the particular chromosome which it represents, so that in such case we would have a much more perfect mechanical model of the human germ-plasm.

The machine here pictured is built of one-half inch strips of wood; the surface of the frame, without the handle, measures 5½ by 18 inches. The spools, or chromosome-models, are made of 1-inch cylinders 1 inch long and mounted on iron rods, so that they may be turned or spun with ease, but each has a catch which meshes into a notch in the rod so that the spool is much more apt to stop at an exact half-turn. This notch-and-catch contrivance is convenient but is not essential, for there are only twenty-four spools to be spun, and after brushing or raking them for the purpose of securing random or chance assortment, the few small adjustments necessary to secure exact alignment require only a few moments.

If there are twelve[1] chromosomes in each human gamete, then there are twelve linkage-groups of traits in man. The breaking-up of these groups would be proportional to the rate of crossing-over in gametogenesis. Whether the genes for the particular twelve traits indicated on this particular abacus lie in separate chromosomes we do not yet know. In future years the instructor in genetics, in manufacturing a germ-plasm abacus, will keep pace with the growth of knowledge of the linear geography of the human gene, just as he will of the shape and relative size of the several chromosomes. But it is useful and perfectly proper to present this tentative arrangement, because the traits indicated have been studied to a considerable extent, and, so far as known, none has been shown to be correlated with another here listed. But by the laws of chance future knowledge will prove several cases in which more than one of this random list lie in the same chromosome, and consequently other chromosomes will be blank so far as the present list is concerned, but by linkage and crossing-over studies the blanks will be readily filled by other genes properly located.

When two or more human genes are demonstrated to lie in the same chromosome, and their relative positions in

[1]Cytologists have not yet agreed on the number of chromosomes in man. According to von Winiwarter (1912) the diploid number is 47 in the male and 48 in the female. According to Wieman (1917) the diploid number is 24 in both sexes, but one pair of which are the idiochromosomes *xy*. (See also Guyer, Montgomery, Jordan, Stevens and Evans.)



AN ABACUS FOR ILLUSTRATING THE STRUCTURE OF THE HUMAN GERM-PLASM. (Fig. 21.)

the chromosome are known, their symbols may be inscribed in their true linear relationship upon the same spool in the germ-plasm abacus. Their genetic behavior will then be automatically demonstrated in manipulating the machine in the usual manner. With this understanding the tentative list may well stand, but the fact that the given assortment is arbitrary does not destroy its teaching value in demonstrating the proven structure of the germ-plasm, the mechanical principles and mathematical possibilities in the segregation and recombination of traits.

The following paragraphs describe the features of this abacus and their analogies in the human germ-plasm:

1. The curved surface of each spool is divided vertically by black marks into two equal areas, each of which represents one of the two possible chromosomes, either of which the parent manufacturing them may contribute to the F_1 zygote. One of these chromosomes the said parent in turn received from his or her father, and the other from his or her mother.

2. The front face of each chain of spools, in any combination, represents the number and genic composition of the chromosomes characteristic of the gamete contributed to the F_1 zygote by the parent proliferating it. If desired one "chromosome-face" may be labeled ♂ to indicate its paternal origin and the other ♀ to show its maternal origin.

3. The two sets of spools are in parallel and homologous position, as probably is the case with chromosomes just before the formation of the equatorial plate when the gametes fuse to make the fertilized egg or zygote. But still more definitely this parallel and homologous position is exactly analogous to the chromosomal situation during para-synapsis, preceding the first maturation division.

4. All of the potentialities of the two parents in reference to their chromosomal combinations (barring crossing-over and other special phenomena) are here shown mechanically and may be mathematically demonstrated by turning the spools into their several possible combinations.

5. With this apparatus one may give a mechanical demonstration of the three normal genetic types of parents, and the consequent six types of Mendelian matings in reference to a single trait. The student examining the abacus here shown soon finds that, so far as breeding potentialities are concerned, the F_1 male parent (the father) is positively homozygous, that is, duplex in reference to traits C, H, T, and R; the mother in reference to traits X and H. The father is heterozygous, that is, simplex in reference to traits X, P, S, I, K, D; the mother to traits P, O, I, K, R. The father is negatively homozygous, or nulliplex, in reference to traits g and o; the mother to c, g, s, t, and d.

6. Let us next consider the possible types of matings. The gene H for the trait here shown in chromosome g presents an example in Mendelian Case 1 (DD × DD = 100% DD.) Genes X and R here listed in chromosomes x and j, Case 2 (DD × Dr = 50% DD and 50% Dr.) Genes C and T in chromosomes a and i, Case 3 (DD × rr = 100% Dr.) Genes P, I, and K in chromosomes b, f and h, Case 4 (Dr × Dr = 25% DD, 50% Dr and 25% rr.) Genes S, O and D in chromosomes d, e and k, Case 5 (Dr × rr = 50% Dr and 50% rr.) Gene g in chromosome c, Case 6 (rr × rr = 100% rr.)

7. In most bi-sexual species, the cause of sex, so far as it has been traced in the reverse order of ontogeny, is found to lie in a chromosomal difference in the zygote and gamete. Sex-difference for the most part is the principal somatic difference within a species. It is therefore logical to expect a greater difference between the chromosomes of a male-producing and a female-producing zygote than will be found to accompany any other contrasted traits within the same species. In man the male is heterozygous, the female positively homozygous. In the

accompanying apparatus the spools pictured as representing the x-chromosomes are labelled to show the fundamental sex-plan, and other symbols are added representing the presence and absence of the gene for color-blindness, which is known to be a sex-linked trait. When the machine is manipulated, it presents a correct mathematical picture of the sex-ratio and of the distribution of sex-linked traits among the children of the parents described on the margin.

This abacus does not demonstrate all of the phenomena of bi-sexual heredity, but it gives a correct structural and mathematical picture of the basic properties of the human germ-plasm. The pedagogical value of the machine would be lessened if it were made more complex. Rather than complicating this device, other machines should be contrived for illustrating such special phenomena, for example, as crossing over and non-disjunction.

8. In manipulating the machine, the novice learns that in normal cases in each egg or spermatozoon there is always a maternally or a paternally descended chromosome (one or the other of the two faces of a spool) representing each definite chromosome characteristic of the gametes of the species. Then in reference to the descent-combinations of two chromosomes, for example, a and b, a given parent is capable of producing four kinds of gametes. In general the total number of descent-combinations of chromosomes possible in the gametes of a given individual is equal to 2^n, in which n is the number of chromosomes characteristic of the gamete (that is the haploid number) of the particular species. He learns also that for each single pair of contrasted traits there are four possible definite chromosomal combinations in a zygote organized from the gametes of two given parents. Thus barring crossing-over and other special phenomena, the number of possible chromosomal combinations in the zygote which may result from a particular human mating is 4^{12}. If the formula be generalized, then the number of different chromosome-combinations possible among the full brothers and sisters of any bi-sexual organism, barring crossing-over and other special phenomena, is 4^n, in which n is the number of chromosomes characteristic of the gametes of the species.

9. If, when the machine is set for a given F_1 zygote, the examiner turns it over, he finds on the backs of the spools the genes reciprocal or allelomorphic to those found on their respective fronts. In the case of the paternally descended gamete, the reciprocal is another possible spermatozoon, which by chance was not used in making the F_1 zygote organized as shown by the front of the spools. This reciprocal gamete has all of the genetic possibilities of the male parent other than those which are not contained in the spermatozoon which actually entered the particular F_1 zygote.

10. The case of the reciprocal of the female gamete or ovum is somewhat different, so far as ability to function as an egg is concerned, but in the reciprocal or allelomorphic nature of the chromosomes and genes, the situation is exactly parallel to that found in the case of the male gametes. The cell reciprocal to the ovum is the second polar body,[2] and having the chromatin composition in the nucleus required of a perfect egg, would perhaps so function if its cytoplasmic composition were adequate.

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[2]In species in which the first maturation division consists in organizing two dyads of exactly similar composition, the allelomorphs (that is the backs of the spools) of the female gametes shown by this abacus properly represent the second polar bodies. If, however, the first maturation division results in two dyads of dissimilar composition, that is one completely paternal and the other completely maternal in origin, the allelomorph of the ovum as shown on the back of the spools presents a gene-picture of one of the two cells resulting from the division of the first polar body. So far as this particular point is concerned, this machine, because the back is in the appropriate place labelled "Second Polar Body," rather than "Polar Cell," represents faithfully those forms in which the two dyads are exactly alike.

11. Thus every parent, in reference to a single trait, may contribute one or the other of two genes, one of which came down unchanged (barring mutation) from his or her father, the other from his or her mother. Of course, if the blood is pure and these two genes are alike, they cannot be distinguished in their working-out in the F_1 soma. This is the case with trait H in chromosome g, and trait g in chromosome c, but this does not mean that the rules of segregation and recombination have not been just as active throughout as is so easily demonstrated with the highly contrasted genes and characters of mongrels.

12. In order to represent the continuity of the germ-plasm, let the F_1 zygote be thought of as a parent. Whereas the possibilities of the original P_1 individuals of the abacus for a single trait are shown by the two faces of a single spool, now the possibilities of the F_1 individual as a parent are shown by the front faces of the two adjacent spools, which are now held stationary. Those genes whose symbols are indicated on the backs of the spools have been lost to the race in this particular case. Thus not only the principles of segregation, combination and continuity, but also of elimination, are mechanically shown. To every one of the descendants of the F_1 zygote, one or the other of the two chromosomes or genes-radical shown on the front faces of adjacent spools will pass. If two of these abaci are placed side by side, with the spools stationary in one abacus to represent a parental male zygote, and in the other a parental female zygote, the situation may be used to demonstrate the inbreeding of the F_1 generation, but instead of spinning the spools the combinations for the F_2 offspring are made by chance selection of either the right or left (that is, either paternally or maternally descended) face of the front-turned spools in the two abaci. By this process one may trace the chromosomes and their component genes from generation to generation.

The manipulation of this machine gives not the whole story of human heredity, but a clean-cut demonstration of the geography[3] of the bi-sexual germ-plasm and of its normal basic mechanism and mathematics.

Moral Qualities and Eugenics

The Lancet (London, November 8, 1919) says: "Dr. I. M. McCaillie has published certain results obtained by this method (psychological tests) in the American Army, and it is interesting to note that a majority of cases of absence without leave, desertion, confinement to barracks, and reduction in rank occur among men found to be below the average of intelligence, as shown by the tests employed, and the use of psychologists to investigate the mentality of criminals might well have fruitful results."

Any measurements of moral differences among adult human beings are so rare that notice should be taken by psychologists and eugenists of the results obtained by Dr. McCaillie. They confirm the correlation of mental and moral qualities found by Woods in royalty (1903).[4]

There have been some scattering figures obtained by persons who have made studies of school children and particularly of delinquents in state institutions, all of which support the notion of mental and moral correlation.[5]

If morally superior persons are on the average more liberally endowed mentally it means much encouragement for the eugenists in their ideas for the betterment of mankind.

[3] See (a) "The Physical Basis of Heredity," by T. H. Morgan. (b) "Are Genes Linear or Non-Linear in Arrangement?" by W. E. Castle, Proceedings of the National Academy of Science, November 1919.

[4] The correlation ratio was found to be $r = .34 \pm .04$, "Heredity in Royalty," New York, 1906, p. 259.

[5] See Journal of Heredity, Feb., 1919, pp. 84–86.

A PHYSICAL CENSUS IN ENGLAND AND ITS LESSON

Two-thirds of the Population Not Healthy

THE RESULTS of the physical examinations of drafted men in England for the first eight months of 1918, show that "between January 1 and August 31, 1918, the number of medical examinations conducted by National Service Medical Boards in Great Britain amounted to 2,080,709. Of the two million men examined not more than 36 or 37 per cent were placed in Grade 1—that is, approximately only one in every three has attained the normal standard of health and strength and was capable of enduring physical exertion suitable to his age; the remainder—more than a million and a quarter—did not reach this standard. The suggestion has been made that the low proportion of fit men among those examined during this period was due to the fact that only the leavings of the population were under review. Analysis of the records available, however, shows that this is not the case, and that as a fact the men examined constituted a fair example of the male population between the ages of 18 and 43 and a smaller proportion of the more fit between 43 and 51. We are told further that the experience of the boards medically examining women for national works corresponds broadly to that of the National Service Medical Boards examining men. Such evidence points only too clearly to a deplorably low state of health."

In comment on the above the Editor of the *British Medical Journal* makes the following remarks:

"While it has not yet been possible to work out the details of this great mass of medical examinations, the preliminary results indicate that preventable disease is responsible for the bulk of the physical disabilities, and demonstrate the ravages which industrial life has made upon our real national capital —the health and vigor of the population. Too little food, too long hours of work, too little sleep, too little play, too little fresh air, too little comfort in the home are evidently the chief factors concerned in producing this mass of physical inefficiency with all its concomitant human misery and direct loss to the country. To take effective measures on the broadest lines to remedy this condition of things is a most urgent duty. Although real improvement can hardly be expected for one or two generations, the foundations of a better national physique can be laid at once[1]."

It would seem that this editorial writer in the *British Medical Journal* does not see into the complexity of the problem, or understand modern views on heredity. In so far as these disabilities are the result of a bad environment, an improvement may be rightly expected to accrue, and this change for the better may be looked for at once, not, as the editor supposes, after one or two generations. Does this writer cling to a belief in the inheritance of acquired traits? But is it not conceivably possible that this physical deterioration is *in part* due to an adaptability of mankind to a less brutal system of natural selection than took place among our primitive ancestors? Indiscriminate charity and excessive altruism, to say nothing of the inevitable and commendable features of civilization, have doubtless enabled the congenitally weak to survive. Large portions of the population are not healthy (Grade I in the martial sense), but they are nevertheless healthy in sense of being able to survive and beget offspring. This feature of the problem cannot be either denied or ignored.—F. A W.

[1] Edit., *Brit. Med. Journal*, 1918, 348–9.

A SYSTEM FOR BREEDING CORN OR GREGARIOUS ANIMALS

A. N. Hume

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During the past three years, the writer has attempted to conduct a corn breeding system that should accomplish the three following requirements:

(1) Insure continuous ear-to-row selection for high yield by using ears or remnants from tested rows.

(2) Insure direct cross-pollenation between high yielding strains, thus avoiding the usual ill effects of in-breeding; with the use of a single ear in each quarter of the plot for all sire rows and detasseling all even-numbered rows.

(3) Annual introductions of strains from outside sources, *through the even-numbered detasseled rows of the breeding plot.*

The first of these attempted requirements is based upon the assumption that some sort of selection is bound to be the basis of progress in corn-breeding. The second is intended to recognize the principle that it is usually desirable to secure the crossing of strains that have previously been inbred or at least closely bred. (Hybridization Methods in Corn Breeding. Shull —*American Breeders Magazine,* April-June, 1910.) The third feature namely, the introduction of outside strains, conforms to the idea that "selection is a sieve," or at least it may be. There can hardly be a practical reason why a corn breeder should start with a given number of mother ears, say ninety-six, and assume that all determinants of high yield are included within the number originally selected.

Furthermore, the plan of introducing ears from outside the breeding plot into the even-numbered detasseled rows gives opportunity for testing the yielding power of such introductions before permitting them to mature pollen, and consequently makes it possible to discard them entirely if they are found unworthy, without contaminating the other "blood lines" of the breeding plot. This idea conforms to the earlier suggestion of Williams of Ohio. The plan, or combination of plans employed here is described concretely in the South Dakota Experiment Station Bulletin No. 186.

The writer would suggest that this idea of making introductions into corn breeding plots through the "dam lines" ought to be extended. The chief reason for adhering to the plan of dividing the breeding plot into four squares of twenty-four rows each (adapted from Illinois Experiment Station Bulletin No. 100) is to secure a greater number of relatively short rows and a relatively large number of introductions into these "dam rows," and also to enable one to plant all "sire-rows" in each quarter with a single ear.

It is arbitrary enough to make four quarters of a corn-breeding plot with all odd-numbered rows in each quarter planted from a single high-yielding ear, and with all the twelve even-numbered rows detasseled, with three new introductions among the twelve each year. It works out conveniently.

The essentials of the plan of this corn breeding plot might be adopted by poultry breeders, who have a sufficient number of birds to divide into four pens, each with its quota of hens and one male bird. The rule would be, that all birds in all four pens should be leg-banded and the hens faithfully trap-nested and their egg records kept.

At the beginning of any given sea-

son, the cockerel for pen No. 1 would be selected from the brood of the hen with the highest egg record in pen No. 4. The cockerel for pen 2 would, in like manner be the progeny of the hen with the highest egg record in pen 3. The cockerel for pen 3 would be selected from the progeny of the hen with the highest egg record in pen 1, and the cockerel for pen 4, would be selected from the progeny of the hen with the highest egg record in pen 3.

With such an arrangement, introductions of new blood lines could be made by the addition of one or more hens to each or all of the four pens. Such hens would of course be carefully numbered and their records kept, and in the event they failed to make a worthy record, they themselves and all their progeny could be eliminated from the flock by culling.

It is worth oft repeating that the art of breeding will be most rapidly forwarded on a general basis of rigid selection with statistical records of performance. The device here outlined, for corn, or poultry, may increase interest and intensity of selection; calling especial attention to the possibility of making introductions of new blood lines in a systematic way through the female side.

Another consideration in offering this 4-parted system for breeding corn or gregarious animals consists in its adaptability to cooperation in breeding work. For instance in poultry breeding it may prove impracticable for any given breeder to arrange four pens as suggested in the foregoing. In such a case it may be possible for four poultry breeders each to arrange one pen, and to so cooperate that all may get the benefit of a systematic unit. Such cooperation would inevitably be beneficial to corn, or poultry, or sheep, or what not; it would be a community service along a specific line.

As such it is worth consideration by various community advisers.

Race and Nationality, an inquiry into the origin and growth of patriotism, by John Oakesmith, D. Lit., M.A. New York: Frederick A. Stokes Co., 1919. Pp. 300. Price. $4.00.

Dr. Oakesmith begins by wiping up the earth with authors who have held racial differences to be the basis of differences in national feelings. On the whole, he makes a good job of this—but then, he has picked out the extremists, whose work was most vulnerable, for his attack. He concludes that "race, as a constituent element in nationality is a purely subjective emotion;" and then builds up his own theory, which explains nationality as "the common interests of a people developed through generations into a characteristic traditional culture." Few reasonable people will object to this definition, and they will find much of interest in the rest of the book, which is largely devoted to illustrating, by the case of England, the development of a feeling of national consciousness. The book is, however, marred throughout by the absolute lack of a biological viewpoint, and by a literary rather than scientific treatment of the facts.—P. P.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

VOL. XI, NO. 5 MAY-JUNE, 1920

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See Special Note Below.

NOTE

The Journal of Heredity at the original pre-war price of only $2.00 ran into a raise of fully 100% in the cost of its manufacture. The membership dues did not cover the costs, and support was difficult to arrange for, but the necessary financial assistance has been secured, and four bi-monthly numbers will now appear in quick succession to complete Volume eleven (1920). The Journal will then resume its regular schedule at the price of $3.00 determined upon by the Council last June.

Canadian members pay $3.25 and foreign members $3.50, the extra amount being necessary to pay postage. Price of single copies 35 cents.

The next numbers will contain illustrated accounts of some of the most important discoveries which have yet been made in this new field of science, and it is hoped will satisfy those members to whom the long wait for the Journal has been discouraging.

The interest in the subject of heredity is growing rapidly, and if each member would nominate a few friends who are eligible the Association will be self-supporting next year.

Date of issue of this number, January 20, 1921

COLOMBIA'S GIFT TO AMERICAN PLANT BREEDERS

A Colombian Highlander Holding Up an Armful of the Giant Blackberry of the Rain Forest of Fusagasuga

This remarkable species does not form compact bushes but sends up scattered shoots from underground stems. It is half climbing in habit, its stems reaching to a height of ten feet. At the base of each leaf is a pair of clasping stipules which distinguish it from other species. The flower clusters (terminal racemes) rarely carry more than five flowers and often only one fruit is set. In the photograph the berries are scarcely more than half grown. Photograph by Wilson Popenoe, October 1920. (Frontispiece.)

THE COLOMBIAN BERRY OR GIANT BLACKBERRY OF COLOMBIA

Wilson Popenoe
Agricultural Explorer, Office of Foreign Seed and Plant Introduction

THAT a fruit of such remarkable character as the Giant Blackberry of Colombia should have remained so long undiscovered to horticulture can only be explained by the fact that it grows in a region remote from the established routes of travel—a region which has, until recently, remained horticulturally unexplored.

So far as known, the species has never been called to the attention of the horticultural public. It was, however, brought to the attention of the U. S. Department of Agriculture several years ago by Dr. Frank M. Chapman of the American Museum of Natural History, who had observed the plant during his travels in Colombia. The services of Frederick L. Rockwood were enlisted at Dr. Chapman's suggestion, and in 1914 a few plants were introduced into the United States through the Office of Foreign Seed and Plant Introduction. These plants were obtained by Mr. Rockwood at a spot called El Peñon, on the road between Sibaté and Fusagasugá, in the department of Cundinamarca.

SEED AND PLANTS OBTAINED

Soon after my arrival in Bogotá I put myself in touch with Mr. Rockwood, and by him was directed to the region in which the plant is found most abundantly. I have been on the watch for it in other parts of Cundinamarca as well, and have thus been able to gain some idea of its distribution. I have obtained numerous photographs of the plants, flowers and fruits; botanical specimens of foliage and flowers; and I have forwarded to Washington a quantity of seed and a limited number of strong young plants. With this material in hand, it should be possible to arouse the interest of North American horticulturists in the species, and to give it a fairly wide distribution in those portions of the United States where it seems to merit a trial.

VALUABLE MATERIAL FOR PLANT BREEDERS

While the plant grows in Colombia at elevations nearly ten thousand feet above the sea, it must be remembered that at four degrees from the Equator it is not cold, even at such an elevation: and there are no grounds for assuming that the plant will be sufficiently hardy for cultivation generally throughout the United States. It does seem reasonable to expect, however, that it will be successful in the milder portions of the South and West. The chief interest of the species probably lies, however, not in its value as a fruit for widespread cultivation in its present form, but in its possibilities when placed in the hands of plant breeders. A species of Rubus which produces, as a wild plant, fruits two and a half inches long by an inch and a half in thickness, and these of fairly good quality for eating, can not fail to possess great interest to North American horticulturists!

DISTRIBUTION AND NOMENCLATURE

The species was reported by Dr. Chapman from a region on the road between Sibaté and Fusagasugá. While it occurs elsewhere in Cundinamarca, I have found no other region, as yet, in which it is so abundant, nor in which the fruits reach such large size.

Its distribution in the region between Sibaté and Fusagasugá is limited to an area bounded on the north by the descent onto the sabana (plain) of Bogotá, and on the south by the abrupt

A BASKET OF THE COLOMBIAN BERRY, NATURAL SIZE

When it is considered that this berry is a wild one, having never been brought under cultivation, that its individual fruits measure 2¼ inches in length as they are picked from the wild bushes and that plants of it have wintered through when protected in the Puget Sound region where some of the finest berries in the country are produced, the possible value of this gift from our sister republic COLOMBIA becomes apparent. What breeding and selection may do with this berry must be left to the Plant Breeders to determine. Photograph by Wilson Popenoe. October 1920. (Fig. 1.)

descent of the peñon into the valley of the Rio Barroblanco. This leaves a zone about one mile in width, in which the plant is found—a zone on the upper edge of the escarpment, but not extending across the mountain tops onto the slope toward the sabana. The region is one of peculiar climatic conditions: it is that upon which the clouds drifting up from the lowlands of the Magdalena valley impinge and frequently precipitate their moisture, and it is thus kept cool and wet throughout most of the year. It is a region characterized by tree-ferns, bamboo, begonias, several melastomaceous and ericaceous shrubs, *Drimys granatensis*, one or two species of Berberis, and several species of Rubus which sometimes cover the ground over areas an acre or more in extent.

EXTENT OF RANGE NOT KNOWN

Elsewhere in Cundinamarca I have seen the plant, or learned of its existence, only on the western or southwestern slope of the range which rises from the western edge of the sabana of Bogotá and falls away toward the Magdalena valley. Mr. Rockwood has recently reported the plant from Dentel, north of Facatativá. So far as I have observed, it is found only at elevations between 8,000 and 10,000 feet; further observations may, and probably will, extend this range.

SPECIES PROBABLY *Rubus roseus*

Botanically I have not been able to determine the species. No one in Bogotá with whom I have talked is familiar with the botany of this genus, and none of the local botanical works to which I have had access describe a plant which I can identify as this species. The characters of the plant seem to agree with those attributed to *Rubus roseus* in a key to the Central and South American species of Rubus which has been sent me by George M. Darrow. They also agree rather closely with those of *Rubus macrocarpus*, except that the latter is many-flowered, and I do not think this can be said of the plant in question. *Rubus roseus*, on the other hand, is said to produce few flowers; its fruit is described as "purple," which is not exactly true of the Colombian Giant Blackberry; yet it would be easy for a slight mistake to be made in this matter, and it seems to me on the whole that the characters of *Rubus roseus*, as given in the key, are those of the plant under consideration.

The popular nomenclature of the different species of Rubus in the Bogotá region is limited to a few terms applied rather loosely. In general, all of the species which produce fruits of blackberry character are termed *mora*, the correct name in Spanish for the mulberry (*Morus nigra*) and also for the fruit of the cultivated blackberry. One or more species whose fruits have large, hard seeds are termed *mora de poedra*, or stone-blackberry, because (I take it) their seeds are like small stones (though one Colombian told me it was because they grow in stony places, which is not commonly a fact). Several species whose fruits are of good quality for eating, and are sold in the markets of Bogotá and other cities, are called *mora de Castilla*, or blackberry of Castile (Spain). The phrase *de Castilla* is applied in Cundinamarca to various products of the country; thus there is a *curuba de Castilla* (*Tacsonia mollissima*), no more a native of Spain than the various species of Rubus to which the term is applied. The phrase *de Castilla* may, in fact, be taken to mean that the product is one of the best of its class. It is undoubtedly a heritage from Colonial days, when the best of everything was supposed to come from the Mother Country.

The Giant Blackberry is termed by natives of the Peñon section *mora*, and *mora* alone; though when pressed for a more specific name they will sometimes say it is a *mora de Castilla*, i.e., a good mora. In Bogotá the fruit is often termed *mora de Castilla*, but this name is applied to at least two other species which are more common in the market than the one under consideration.

AN ENGLISH NAME FOR THE BERRY

The species has, of course, no common name in English as yet. On those few occasions when it has been mentioned in the United States, it has usually been referred to as the Giant Blackberry of Colombia. Since the fruit is not black and the plant differs in habit from the cultivated blackberries of the North, I believe it would be appropriate to introduce the species into horticulture not as the Giant Blackberry, but as the Colombian Berry; thus doing honor to Colombia, and at the same time identifying the species permanently with its native home, and distinguishing it from numerous "giant" blackberries which have been and will be introduced into horticulture in the United States. The term "Colombian berry" is in conformity with the nomenclature used in this genus, in which we already have loganberry, salmon berry, Northey berry, and so on.

DESCRIPTION OF PLANT

The plant, which does not form a compact bush in most instances, but sends up scattered shoots from underground stems, is half-climbing in habit. By proper training it could probably be made to form a shapely bush, or at least the canes could be so pruned as not to require any support. In the wild state, many of the canes grow half erect, while others scramble over the nearby vegetation.

The stems reach a maximum length of about nine or ten feet. Near the ground they are commonly half an inch thick, the diameter growing less toward the upper portion of the stem. They are light green in color, covered with short glandular reddish hairs, and abundantly armed with short, stiff, very slightly recurved thorns broad at the base.

A pair of leaf-like, clasping stipules, about an inch in length and breadth, is found at the base of each of the leaves. The latter are normally trifoliate, and up to more than a foot in length. The petiole is up to six inches long, slightly grooved above, thorny and hairy like the canes. The petiolules of the lateral pair of leaflets are one-fourth to one-half inch long, that of the central or terminal leaflet one to two inches long. The leaflets are commonly oblong-ovate, elliptic, or ovate in outline, subcrenate, three to six inches long, cordate at the base and acute to shortly acuminate at the apex, bright green and very finely hairy above, paler beneath, with fine hairs only on the nerves. The leaf-margin is dentateserrate.

The small, axillary or terminal racemes rarely carry more than five flowers. Frequently a leaf-axil gives rise to but one fruit, and clusters of more than two are rare, and usually terminal. The calyx is very prominent, the petals obovate in outline, nearly one-half inch long, and light rosy-purple in color.

FRUITS OF REMARKABLE SIZE

The fruits vary from slender oblong to broad oblong, ovoid, or cordiform in shape, and at maturity are one to two and a half inches long, by three quarters of an inch to an inch and a half in greatest breadth. In color they are light crimson, tending to become wine-colored when overripe. They are composed of a large number of relatively small drupelets surrounding a large fleshy, succulent torus which extends nearly to the apex of the aggregate fruit, and at maturity often separates from the drupelets, which cohere loosely inter se. In transverse outline the fruit is often four- or five-angled. At maturity it is rather firm in texture, not as juicy as most of the cultivated blackberries, and of a pleasant subacid flavor (quite acid until the fruit is fully ripe) perhaps suggesting that of the loganberry more than that of the cultivated blackberries.

The receptacle or torus can be eaten along with the drupelets, but when it comes away readily it is often removed before the fruits are eaten (as in the raspberry), and fruits in this condition are often sold in the market.

THE COLOMBIAN BERRY IN VARIOUS STAGES OF MATURITY

This remarkable Giant Blackberry first discovered by Dr. Frank M. Chapman of the American Museum of Natural History on the road between Sibaté and Fusagasugá at an elevation of 10,000 feet in the mountains of Colombia is beyond doubt the largest blackberry yet discovered in the world. It will probably be tender throughout the greater part of the blackberry growing regions of the United States but when the plant breeders of America combine it with the hardy species it may add size and other characters to our commercial varieties. Actual size photograph by Wilson Popenoe, October 1920. (Fig. 2.)

The ripening season is said to extend through practically the entire year but the principal crop matures in October, November and December. The fruits are perhaps more variable in form than those of the cultivated blackberries, and they also vary greatly in size, due probably to environmental conditions more than anything else. I have found the largest ones on soil that is very moist; on poor, dry land they are usually small.

The impression of huge size which one receives when viewing these berries is due not so much to their length, as to the fact that they are broader in relation to their length than is common with cultivated blackberries. The largest specimens I have measured were about two and a quarter inches long, by an inch and a half in breadth. Specimens of such large size are not common, and indeed are rarely seen among the fruits brought into the Bogotá market. I have, however, seen a number of such fruits on the wild plants at El Peñon, produced by canes growing in what could almost be termed a peat-bog.

FLAVOR RESEMBLES LOGANBERRIES

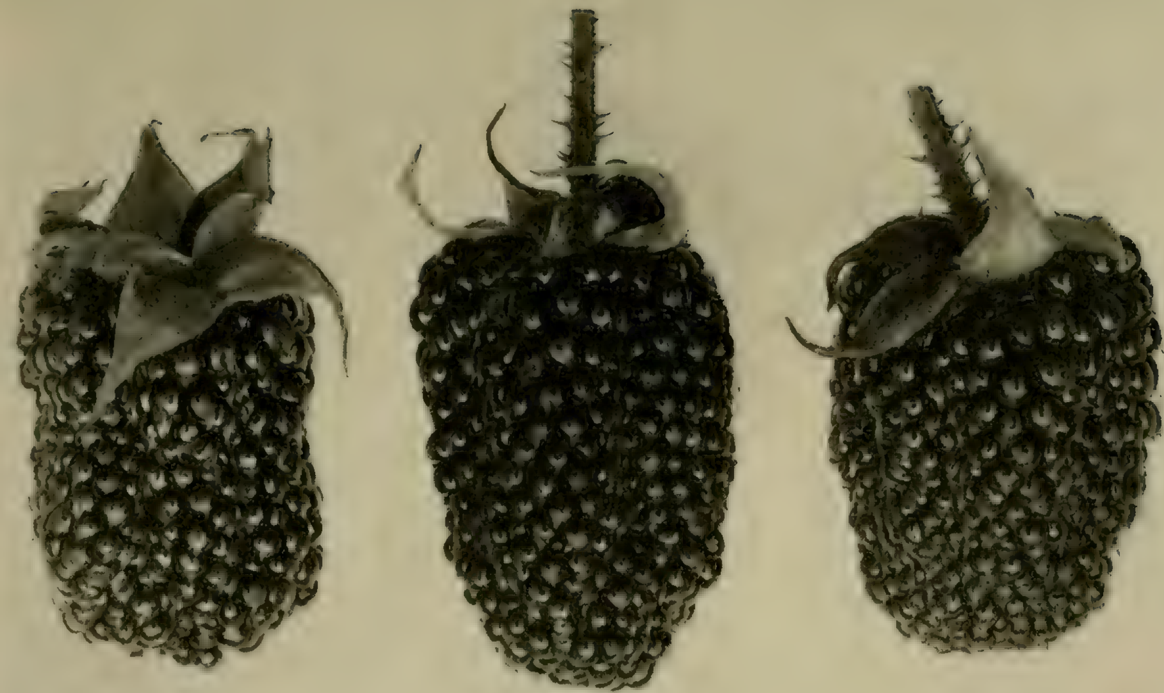
Among Colombians, the fruit is not so popular for eating as that of some of the other wild species of Rubus which also grow in the vicinity of Bogotá. This is due to the fact that there are other species whose fruits are more juicy and less seedy than those of the Giant Blackberry. The latter are, however, brought into the Bogotá market in small quantities, and fetch a good price. They are perhaps better if eaten when fresh, with sugar and cream, than they are when stewed; but it is not common to see them served in this fashion. Usually they are stewed in syrup to form a *dulce* which is served as a dessert. When boiled they become somewhat tough, but they have a rich, delicious flavor resembling that of stewed loganberries.

CULTURAL REQUIREMENTS

Brought into cultivation under favorable climatic environment, it seems reasonable to believe that the Colombian berry will attain much greater size than that reached by fruits borne upon wild plants in the Andes. If it should attain a length of three inches or more, with its proportionate breadth, it would probably stand unique among cultivated species of Rubus so far as size is concerned. Its quality is sufficiently good so that I believe fruit produced by cultivated plants would find a sale in North American markets, where its huge bulk would be certain to attract attention. It will, however, be desirable to improve the species by selection or other methods of plant-breeding: the size of the drupelets in relation to that of the seed may well be increased, the flavor may perhaps be made richer and more aromatic, and the proportionately large size of the torus should certainly be reduced. These are all changes which can probably be effected by means of selection alone. There is, also, the possibility of obtaining valuable new fruits of large size by hybridizing this species with some of the cultivated blackberries or allied species of the genus Rubus. It will be desirable to improve the productiveness of the plant by some means, in order to make its cultivation commercially profitable. Likely, however, much can be done toward this end by proper pruning, an operation of much importance with many members of this genus.

PLANT PREFERS MOIST, COOL CLIMATE

As to the climatic requirements of the plant, it would appear from its occurrence in Colombia in a limited area of particular climatic conditions, that it is exacting in this respect. It is entirely possible, however, that it can be made to succeed under natural conditions considerably different from those of its native home, if given the proper cultural treatment. This can only be determined by experiment. Judging by conditions in the Peñon section, and in general throughout the territory in Cundinamarca in which the plant occurs, one is perhaps justified in predicting that the Puget



ACTUAL SIZE PHOTOGRAPH OF "COLOMBIAN" BERRIES

This wild berry from Colombia is different from every other species. It is appropriate to name it the COLOMBIAN BERRY in honor of the country whose gift it is to the horticulture of the world. It is botanically closely related to *Rubus roseus* described by Geo. M. Darrow. It appears to have no name among the Colombians which is truly distinctive, being called merely *mora*, a term applied in Spanish to the mulberry. It is a giant blackberry although in color its fruits are light crimson tending to become wine red when overripe. The largest are $2\frac{1}{4}$ inches long by $1\frac{1}{2}$ broad and are often angled in shape. It is not as juicy as most cultivated blackberries, the seeds are rather large, and the core is large but it must not be forgotten that it is a wild form. In flavor it suggests the loganberry. The largest fruits found were produced by bushes growing in what could almost be termed a peat-bog. Photograph by Wilson Popenoe, October 1920. (Fig. 3.)

Sound region is the most likely place for it in the United States. Perhaps, however, the frosts will be too severe for it in that region: temperatures as low as the freezing-point probably never are experienced in the native home of the species. But this does not, of course, prove that it can not withstand any frost. All such matters can be determined only by trial.

It may be taken as evident, I think, that the plant wants a moist soil, and that it prefers a moist, cool climate. It should be tried on the sandy loams of the Gulf States, where it has perhaps a good chance of success, though the climate is hotter in summer and colder in winter than that of its native region.

It should be mentioned, though the inference will already have been made from these notes, that the plant is never cultivated in Colombia, hence no information is available here regarding cultural methods. In the Giant Blackberry of Colombia we have, in fact, a species taken directly from the wild, and possessing, in this condition, far greater economic value than the wild prototypes of many of our cultivated fruits.

NOTE

I cannot refrain from adding this note to Mr. Popenoe's most interesting account of the Colombian berry, for should it or its hybrids ever become valuable fruits in America, the circumstances of its introduction may be of interest to many people.

Upon the return of Colonel Roosevelt's expedition to South America in 1914, the National Geographic Society entertained him in Washington at a dinner party. I was a guest at the dinner and was seated between Dr. Frank M. Chapman and Mr. George K. Cherrie, both of whom had been in Colombia. I affected in my conversation with these explorers to be greatly disappointed over the fact that the Expedition had brought back no seeds or plants of any kind which could be grown in America and become later a living tribute to the sacrifices which the men who formed it had undergone—something which would last long after the stuffed animals had crumbled into dust. In defense of their, to me, indefensible position or for the purpose of making me still more "excited" over the situation, Mr. Cherrie reached across the table and, picking up a small glass, remarked that he and Chapman had seen a blackberry in Colombia, years before, a single fruit of which would fill it. The standing of these scientific men was such that I could not be incredulous, and I proceeded to try to get seeds and photographs of it through correspondence with Dr. Chapman's friend, Mr. Frederick L. Rockwood. Through one cause or another his attempts failed to reveal any blackberry quite large enough to substantiate their stories.

In March, 1918, I met Dr. Chapman and somewhat skeptically asked him to give me again the dimensions of the Giant Blackberry. Dr. Fuertes happened to be present, and, as he had seen the fruit, as well as eaten it, Chapman referred me to him, and immediately he drew for me a pencil sketch from memory of this remarkable blackberry. It was so large that I must confess it taxed my credulity a good deal, and every time I met Chapman I mentioned its incredible size. In June of 1918, Cherrie and I happened to meet again, and to defend himself against my attacks of incredulity, he also drew an outline of his remembrance of the berry. While there is room for discussion still in regard to the actual size of the largest specimen which is to be discovered in Colombia, I think these actual size photographs of Popenoe's, which correspond closely with Cherrie's sketch, but are somewhat under the dimensions given by Chapman and Fuertes, so vindicate the correctness of the Giant Colombian Berry as told by these three eminent scientific explorers as to deserve special mention in connection with this, the first publication of a horticultural account of the species.

David Fairchild
Agricultural Explorer in Charge,
Office of Foreign Seed and Plant Introduction.

A YOUNG COLOMBIAN BERRY BUSH IN ITS NATIVE HOME

This remarkable giant blackberry is found only in a narrow zone at 8,000 to 10,000 feet altitude where the clouds drifting up the Magdalena valley drop their moisture and keep the temperature cool and moist throughout the year. It is a region where bamboos, begonias, and tree ferns luxuriate and approaches more nearly in character the summer climate around the Puget Sound or the Golden Gate than any other in America. The soil on which this bush is growing resembles that of a peat-bog. Photograph by Wilson Popenoe at El Peñon near Sibaté, Dept. of Cundinamarca, Colombia, October, 1920. (Fig. 4.)

ENVIRONMENT AND BREEDING AS FACTORS INFLUENCING MILK PRODUCTION

Andrew C. McCandlish
Iowa State College of Agriculture and Mechanic Arts, Ames, Iowa

MILK is the one indispensable human food and its consumption has a direct bearing on the welfare of the nation. The problem of the dairy farmer is to furnish milk to meet the needs of the people and at the same time realize a fair profit from it. The demand for milk and dairy products is increasing as the population of this country is increasing more rapidly than is the number of dairy cattle. More dairy cattle are needed, but, what is of even greater importance, better cows are needed. Cows of higher producing ability will not only increase the available supplies of dairy products but they will give more economical production.

EXPERIMENTS WITH SCRUB COWS

In an effort to demonstrate the possibilities of improving a herd of poor cows, work with a scrub herd was undertaken at the Iowa Agricultural Experiment Station in 1907 and is still being pursued. A number of scrub cows were purchased in an isolated region of Arkansas and brought to Iowa.

These animals were very inferior, being as far removed from the ideal dairy type as it is possible to get and were apparently of very low producing capacity. So far as was known no purebred bulls had previously been used in the section from which the animals came. The experimental animals had always been allowed to rustle for a living, being forced to subsist on the rather scant supply of grass and hay available. Nothing was known of their previous milk production as their sole function had been to supply a little milk for family use and to raise their calves until they were able to forage for themselves.

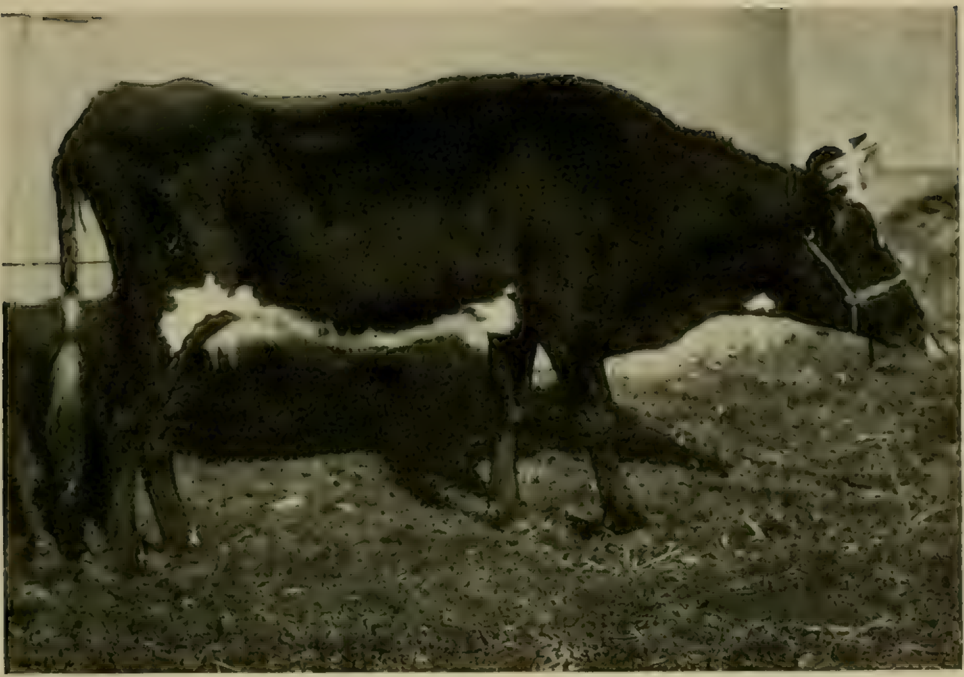
PLAN OF INVESTIGATION

These scrub cows and their heifer calves were put in the Iowa Experiment Station herd and given the same feed and care as the purebred dairy cattle maintained there. The conditions under which the animals have been kept have remained fairly uniform during the twelve years' work.

Accurate records of the milk and butterfat production of these animals have been kept and with their aid the animals have been fed according to their production. The keeping of these records throughout the lifetime of the original animals of the experimental herd gave a basis for the determination of the influence of environment on the production of milk and butterfat.

The scrub cows were mated to purebred sires of the Holstein, Guernsey, and Jersey breeds and the heifer calves resulting from such matings were maintained under the same conditions as the other animals. The heifers by purebred sires were bred to other purebred sires of the same breed and the heifer calves resulting from such matings were also kept for dairy purposes. Records are now available on two generations of grades descended from the scrub cows and one animal of the next generation has just entered the milking herd.

In comparing the records made by cows at different ages it is necessary that an age allowance be made as the maturing of a cow has a considerable influence on her producing ability. For this reason all records of the scrub cows and their descendants have to be

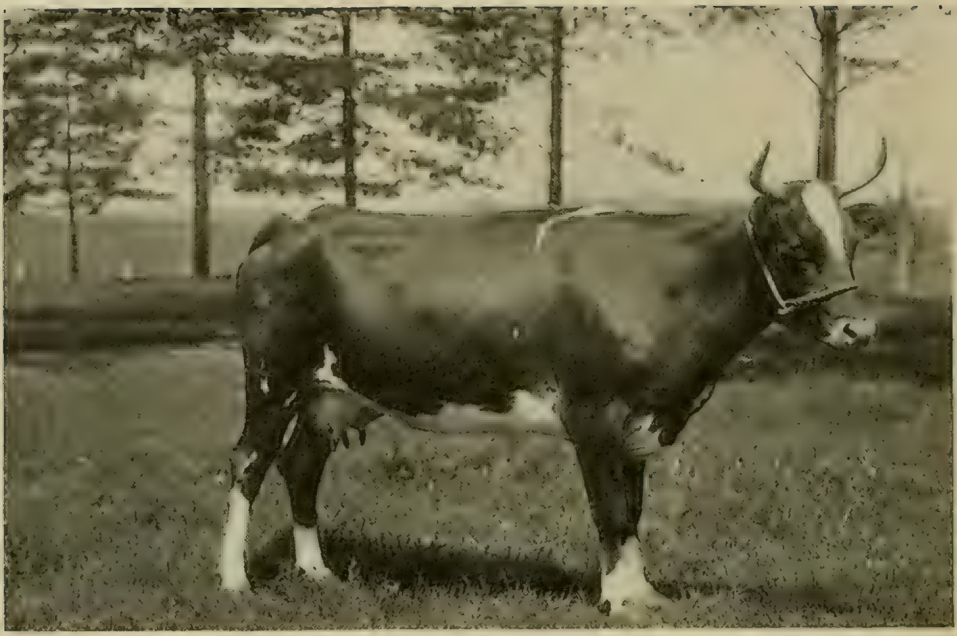


SCRUB COW NO. 6 SHOWING CONDITION AT BEGINNING OF EXPERIMENTS

A specimen of the scrub herd with which the work of improvement was begun at the Iowa Experiment Station in 1907. This cow's record during the first year at the station was 2742.1 pounds of milk and 131.04 pounds of fat. (Fig. 5.)

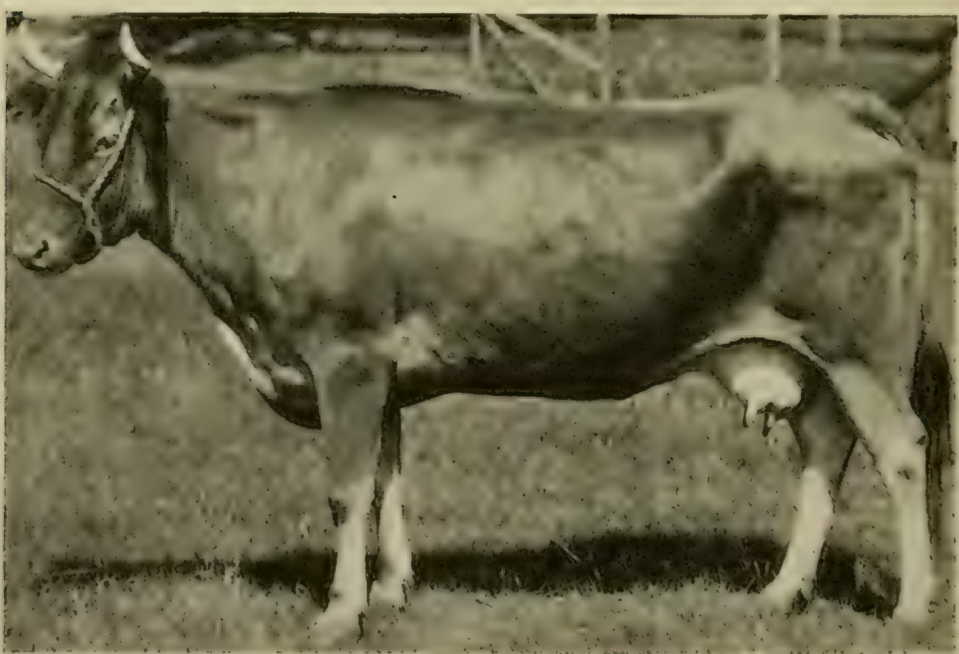
SCRUB COW NO. 6 THREE YEARS LATER

The scrub cows at the Station were given the same feed and care as the purebred dairy cattle there. After three years, this cow produced 5556.7 pounds of milk and 244.79 pounds of fat, an increase over the first year's record of 2814.6 pounds of milk and 113.75 pounds of fat. (Fig. 6.)



SCRUB COW NO. 60

This cow's average production has been 3313.2 pounds of milk and 178.47 pounds of fat. (Fig. 7.)



A HALF-BLOOD JERSEY, NO. 241, FROM SCRUB COW NO. 60 ABOVE

The record of production from this cow has averaged 6137.9 pounds of milk and 349.42 pounds of fat. (Fig. 8.)

THREE-QUARTER BLOOD JERSEY NO. 348 OUT OF HALF-BLOOD JERSEY NO. 241

This cow's average production is 5366.9 pounds of milk and 278.7 pounds of fat. "The scrub cows were mated to purebred sires of the Holstein, Guernsey and Jersey breeds, and the heifer calves resulting from such matings were maintained under the same conditions as the other animals. The heifers by purebred sires were bred to other purebred sires of the same breed, and the heifer calves resulting from such matings were also kept for dairy purposes." (Fig. 9.)

calculated to the mature basis in accordance with a scale obtained from a study of 10,000 records.

TABLE I.—*Percentage of Mature Production Expected of Immature Heifers*

Age	%
Yearlings	70
Two-year-olds	80
Three-year-olds	85
Four-year-olds	95

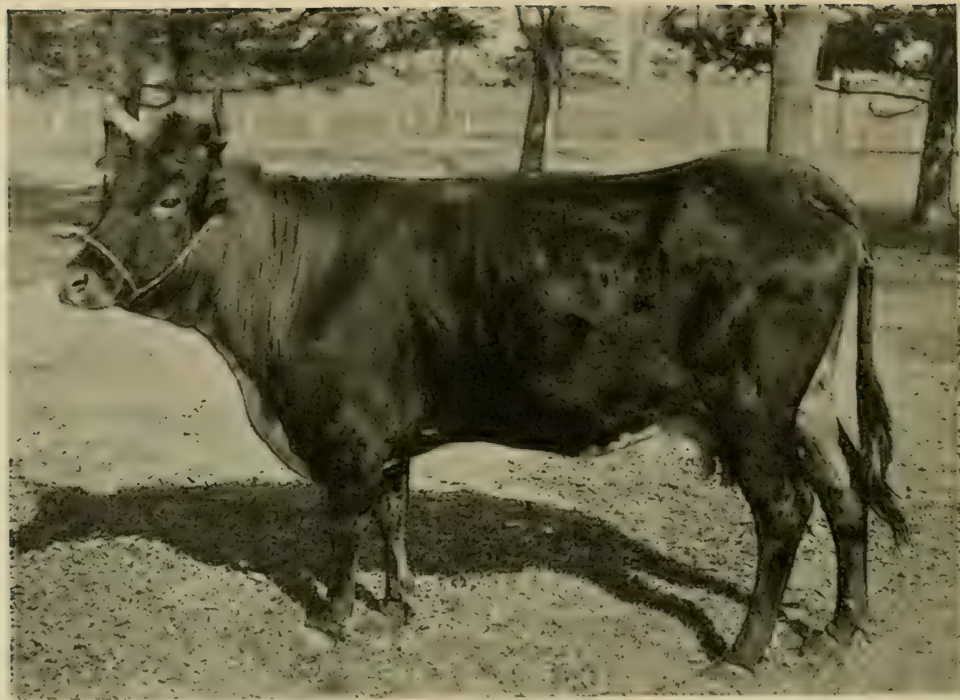
The factors studied in this investigation are of a very varied character and it is necessary that the material relative to each factor be considered separately.

INFLUENCE OF ENVIRONMENT

Of the scrubs that were brought to the station a few were not of producing age, while of those that had reached producing age two were four years old

TABLE II: *Production of Cows That Were Four Years Old on Arrival at the Station*

Lactation No.	Age Years	Average Production		Increase in Production			
		Milk lbs.	Fat lbs.	Actual		Expected	
				Milk %	Fat %	Milk %	Fat %
1	4	3084.6	149.24				
2	5	3984.4	178.97	29	19	5	4
3	6	4618.1	217.79	50	46	8	6
4	7	4907.7	229.91	59	54	10	8
5	8	4224.0	197.59	37	32	12	9
6	9	1991.3	84.76	−35	−43	10	7
7	10	2862.5	133.70	−7	−10	9	5
8	11	2296.2	93.83	−26	−36	5	1



SCRUB COW NO. 33
Average production 4338.5 pounds of milk and 183.49 pounds of fat. (Fig. 10.)

HALF-BLOOD GUERNSEY NO. 87 OUT OF SCRUB COW NO. 33
Average production 4213.1 pounds of milk and 179.72 pounds of fat. (Fig. 11.)

THREE-QUARTER-BLOOD GUERNSEY NO. 236 OUT OF HALF-BLOOD GUERNSEY NO. 87

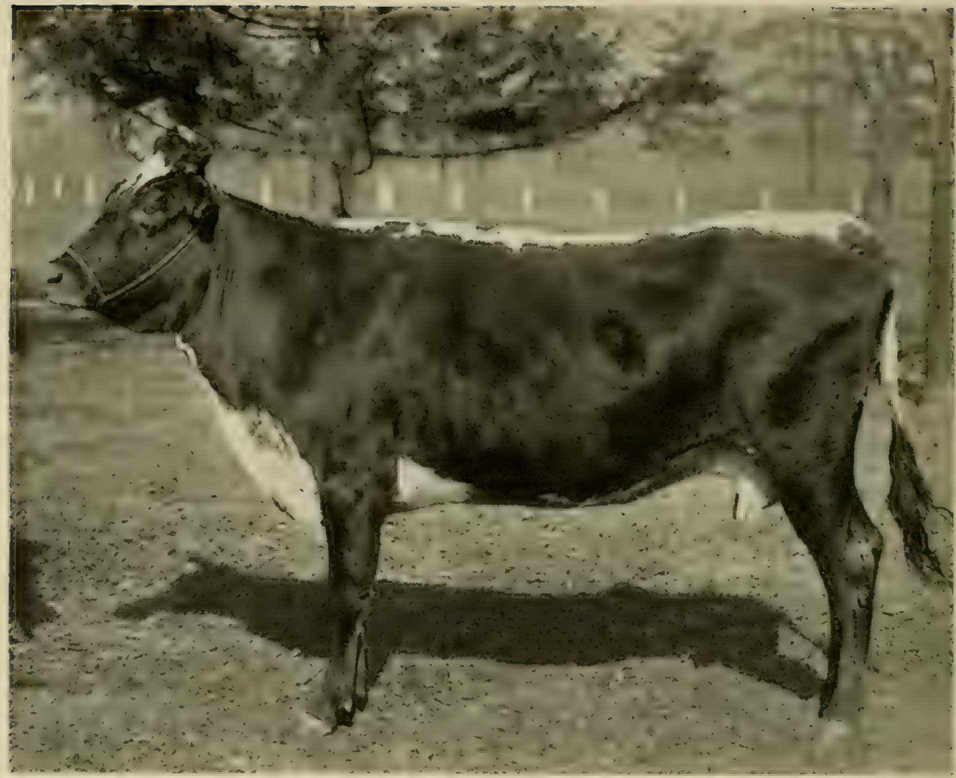
The average production of this cow has been 6345.7 pounds of milk and 320.16 pounds of fat. "Records are now available on two generations of grades descended from the scrub cows, and one animal of the next generation has just entered the milking herd." (Fig. 12.)

and the remainder were mature, that is they were over five years of age. The behavior of those three groups under improved conditions is of interest.

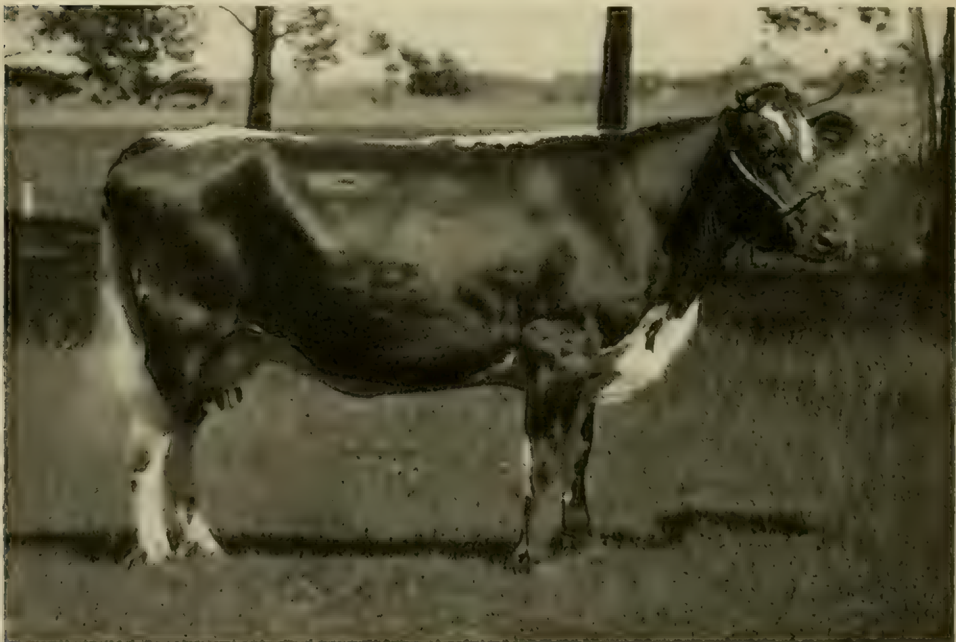
The animals that were four years of age on reaching the station produced an average of 3,804.6 pounds of milk and 149.24 pounds of butterfat during their first lactation period, and with good care and liberal feeding they increased steadily in production until at seven years of age they were yielding 4,907.7 pounds of milk and 229.91 pounds of butterfat, or 59% more milk and 54% more fat than they did during their first year at the station. An increase of only 10% in milk and 8% in fat yield was expected as the result of the maturing of the animals and consequently, the greater portion of the increase secured must be attributed to environmental factors. After seven years of age the decrease in production due to advancing age was quite noticeable—a condition which was expected.

TABLE III: *Production of Cows That Were Mature on Arrival at the Station*

Lactation No.	Average Production		Increase in Production	
	Milk lbs.	Fat lbs.	Milk %	Fat %
1	3790.9	183.84		
2	2874.0	133.50	−24	−27
3	2841.1	141.60	−25	−23



SCRUB COW NO. 56
Average production 3874.6 pounds of milk and 192.62 pounds of fat. (Fig. 13.)



HALF-BLOOD HOLSTEIN NO. 77 OUT OF SCRUB COW NO. 55
Average production 6955.5 pounds of milk and 266.25 pounds of fat. (Fig. 14.)

THREE-QUARTER BLOOD HOLSTEIN NO. 233 OUT OF HALF-BLOOD HOLSTEIN NO. 77

Average production 13366.2 pounds of milk and 497.9 pounds of fat. (Fig. 15.)

TABLE IV: *Average Production of Scrub Cows*

Group	No. of Cows	No. of Lactations	Average Production		Increase in Production	
			Milk lbs.	Fat lbs.	Milk %	Fat %
Mature Cows......	5	15	3168.7	153.64		
Four-year-olds	2	15	3597.7	166.36	14	8
Heifers............	7	28	4036.1	191.21	27	24

TABLE V: *Two Generations of Scrubs Compared*

Dams				Daughters				Increase in Production	
Cow No.	No. of Lactations	Average Production Milk lbs.	Average Production Fat lbs.	Cow No.	No. of Lactaions	Average Production Milk lbs.	Average Production Fat lbs.	Milk %	Fat %
7	3	2366.2	138.20	59	1	3746.9	179.79	58	30
8	3	2339.5	124.35	58	3	3034.5	152.54	30	23
31	7	3463.3	167.95	60	6	3313.2	178.47	−4	6
Aver.	13	2969.3	151.05	..	10	3273.9	170.83	10	13

The cows that had reached maturity before coming to the station all declined in production after their first year even though getting better feed and care than they had been accustomed to previously. It can not be stated, however, that good feed made no improvement in their case as it is undoubtedly true that their records at the station were better than any they previously made under adverse conditions, but they were unable to increase in production during their later years at the station as advancing age brought about a decrease that could not be prevented by good feed and care.

When the scrub cows that came to the station after reaching maturity are compared with those coming at four years of age and those coming before first freshening, it is noticed that those arriving at four years of age produced 14% more milk and 8% more fat, while those coming as heifers produced 27% more milk and 24% more fat than did the older animals. This shows that the younger an animal is when subjected to good treatment the greater is its response.

In other words environmental conditions, or feeding and general care, have a considerable influence on the milk and butterfat production of cows, and the younger animals are when subjected to a certain set of conditions the more readily will they respond.

USE OF SCRUB SIRE

Records are available for three cows and their daughters by a scrub bull, and though this is too limited a number upon which to base definite assertions, certain inferences are justified. Two of the dams were mature on reaching the station while the other was a four year old. Consequently, though the calves received good feed and care from birth, the dams were under favorable conditions for only a limited period of their lives.

The heifers by the scrub bull produced on the average 10% more milk and 13% more fat than did their dams, and considering that these heifers were grown out amid surroundings much more favorable than those which their dams were subjected to at a similar age, it must be assumed that the increase obtained was due, not to the scrub bull but to the feed and care the heifers received.

A scrub bull will sire scrub offspring and no improvement in the production of a herd of milking cows can be obtained where such a sire is at the head of it.

USE OF PURE BRED SIRES

A number of grade animals sired by purebred bulls and descended from the scrub cows have now completed records. These will be studied in two groups—the first generation grades, or those carrying 50% of the blood of one of the recognized dairy breeds, and the second generation grades, or those carrying 75% of the blood of one of those breeds. The only way to determine correctly the value of a bull is to compare the records of his daughters with those of their dams though there are difficulties connected even with

TABLE VI: *Average for First Generation Grades and Their Scrub Dams*

Group	Dams				Daughters				Increase in Production	
	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	Milk %	Fat %
Holstein	4	19	3406.2	168.74	4	18	6444.4	265.92	89	58
Guernsey	6	35	4186.0	189.39	7	20	4899.8	240.96	17	27
Jersey	3	20	4046.7	194.11	3	9	4833.4	265.88	22	34
Average	9	47	3968.6	185.66	14	47	5497.8	255.32	39	37

TABLE VII: *Averages for Two Generations of Grades and Their Scrub Ancestors*

Group	Dams				Daughters				Grand-daughters				Increase in Production			
													1st Generation		2nd Generation	
	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	No. of Cows	No. of Lactations	Milk lbs.	Fat lbs.	Milk %	Fat %	Milk %	Fat %
Holstein....	3	16	3673.8	167.36	3	15	6757.5	275.66	5	9	10063.2	385.46	84	65	174	130
Guernsey....	3	13	4496.6	199.62	3	10	4843.8	229.74	5	8	7744.9	388.23	8	15	72	94
Jersey......	2	13	3394.0	172.52	2	5	5460.5	298.00	2	2	5389.2	282.92	61	73	59	64
Average....	7	36	3847.0	182.40	8	30	5944.7	261.93	12	19	8311.4	375.81	55	44	116	106

this method as will be shown later. This method can not be used for the purposes of comparing breeds as all bulls were not given equal opportunities to demonstrate their abilities as sires of producers.

FIRST GENERATION GRADES

All the first generation of grades sired by a purebred Holstein bull showed an increase over their dams in milk and butterfat production. The increase varied from 38% in fat and 79% in milk to 68% in fat and 121% in milk while on the average it was an increase of 89% in milk and 58% in fat.

In the case of the first generation of Guernsey grades an even wider variation was noticed. It varied from a decrease of 31% in milk and 23% in fat, due to the use of a poor bull, to an increase of 107% in milk and 112% in fat yield. The Guernsey first grade group contained animals that showed the greatest increase and also the greatest decrease in fat production from their dams. The average increase in yield was 17% in milk and 27% in butterfat.

The first grade Jerseys showed variations in production as compared with their dams that varied from a decrease of 19% in milk and 3% in fat to an increase of 85% in milk and 96% in butterfat. The average increase in their case was 22% in milk and 34% in fat production.

All of the first generation grades when taken as a group showed an increase of 39% in milk and 37% in fat production as compared with their dams.

SECOND GENERATION GRADES

The grades of the second generation ranked high in production, producing on the average 375.81 lbs. of fat per year as compared with a production of 261.93 lbs. by their first grade dams and 182.40 lbs. by their scrub grand-dams. In every case the production of the second generation grades was at least 50% greater than that of their scrub grand-dams.

The average increase in production for the second generation Holstein

grades as compared to their scrub grand-dams was 174% in milk and 130% in fat; the increase was 72% in milk and 94% in fat in the case of the Guernsey grades; and for the Jersey second grades it was 59% in milk and 64% in fat production.

The average increase in production for the second generation of grades, when all breeds are combined, was 116% in milk and 106% in fat production—a real tribute to the value of the purebred dairy sire.

In the work that has so far been completed at the Iowa Station on the grading up of a scrub herd of milking cows it has been shown that environment and breeding are very important factors in determining the production of dairy cattle. Good feed and care will increase the yields of milk and butterfat but in order that the best results may be obtained from these factors the cattle must be subjected to good treatment early in life. Animals that are poorly fed and stunted during the period of their development will not respond to good feeding when they reach maturity as readily as will individuals which have been liberally fed during the formative period of their lives. The fact that a high average increase in production was obtained in the case of first generation grades and that the second generation of grades produced more than twice as much milk and butterfat as did their scrub grand-dams thoroughly vindicates the use of the purebred dairy sire for the development of high producing cows.

A Text Book of Biology

Laboratory Direction in Principles of Animal Biology, by A. Franklin Shull, with the collaboration of George R. Larue, Alexander G. Ruthven, Peter O. Okkelberg, and others. Pp. 81. New York, McGraw-Hill Book Co., 1919.

Shull's biology is welcome because it treats of the general principles of biology, rather than merely with details of morphology,—although an adequate amount of the latter is included. No text-book can be letter-perfect, but this one includes a large amount of valuable material, with little that is objectionable. Not all geneticists will accept the definition of genetics (p. 239) as a science dealing with the production of minor features of the organism and the laws that govern their occurrence. Heredity is defined (p. 256) as "the occurrence, in the offspring, of the same genes that were in the parents,"—a definition that some will consider narrow. But the general outlines of the book are so good that it is unnecessary to criticise details, which the teacher will deal with according to his own ideas. The text-book is accompanied by a laboratory manual, which ignores genetics as a subject for experimental study.—P. P.

A Conventional View of Anthropology

An Introduction to Anthropology: a general survey of the early history of the human race. By the Rev. E. O. James, B. Litt., F.C.S., vicar of St. Peter's, Limehouse. Pp. 259, price 7/6. London, Macmillan & Co., Ltd., 1919.

All of the conventional ground is covered by Mr. James in this volume. He presents no new points of view, but has been content to gather together time-tried material, mixing it with some rather tenuous speculation about the daily life of our remote ancestors, and coloring it with numerous references to the tenets of orthodox Christianity. The book is not a notable one, but gives in convenient form a lot of material with which the reader or student taking up anthropology must become familiar. It will perhaps be a good introduction to more detailed study, or an interesting piece of reading for one who desires merely a general survey of the field.—P. P.

HEREDITY IN HORSES

Why the Arab Horse Has Shown Such Conspicuous Ability for Endurance in the Recent Long Distance Tests[1]

H. K. Bush-Brown
Washington, D. C.

THE recent success of the Arab horse in long distance tests calls the attention of the public, and especially breeders, to the genetic value of the thoroughbred blood.

I use the word here in a general meaning and not as applicable solely to the group of registered race horses known as the "English Thoroughbred." In order to be specific let us state the anatomical differences of recognized types of horses, which perhaps will explain why the Arab is such a good weight carrier and capable of endurance under hardship.

To begin with, the Arab's head is smaller and broader, his nose finer, his eye larger and more prominent and alert. His head is articulated onto the neck at a more obtuse angle than other horses. (See Fig. 16.)

His chest is broad, giving plenty of space for heart and lungs, and his ribs are well set out from the spine, giving a relatively large space for carrying the viscera.

The bones of his legs are clean and very dense as compared with other horses and less liable to defects from hard usage. He stands with all his four feet under him, and with straight hind legs. The osselets are small and the dewlap usually wanting or vestigial.

THE ARAB'S SHORT BACK

These differences are sufficient to mark the Arab as a separate family among horses, but the five lumbar vertebrae instead of the six common to all other horses seem to place him in a separate species. As this difference is now recognized by leading anatomists, it may be of importance to those interested to see some illustrations demonstrating these differences. This shortness in the back is usually in the lumbar vertebrae five instead of six, but it occasionally appears in the dorsal instead.

Figure 17 is a photograph of the five lumbar vertebrae of the pure Arab Stallion Nimr whose sire and dam were only one generation from the desert and whose skeleton is in the Museum of Natural History in New York.

Figure 18 shows the six lumbar vertebrae of the famous thoroughbred horse Lexington whose skeleton is in the National Museum in Washington.

There is here a peculiar atavistic tendency shown in the angle of the spine of the one next to the sacral group, it being thrown backward instead of forward as though it would be one of the sacral vertebrae and thus leave only five in lumbar like the Arab ancestors. This, however, would have made too many sacral.

I have already published[2] a long series of these to show that all other types of horses have twenty-four vertebrae in the back except the Arab which has twenty-three, but it is no longer necessary to convince any one of a fact so well established.

VARIATIONS IN SOME TYPES

The skeleton of the imported Arab stallion Haleb in the National Museum, Washington (not yet mounted), has six lumbar vertebrae but only seventeen dorsal vertebrae, so the shortness of his back is maintained although it is found in the forward section instead of in the lumbar, the usual place for it.

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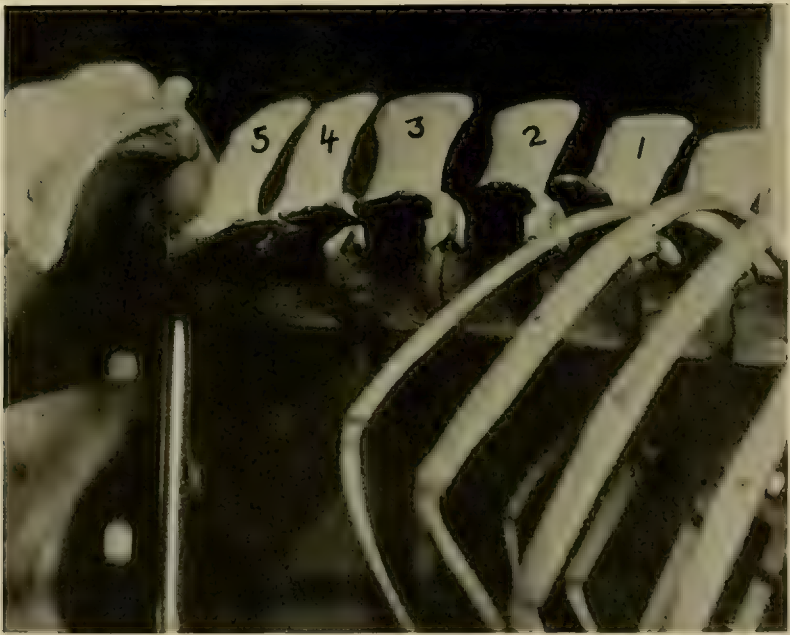
[1] The writer is indebted to Mr. A. H. Chubb of the Museum of Natural History of New York for many courtesies and cooperation. Also to Mr. Warren Delano for his research breeding of Arabs and Norway ponies.

[2] Horses and Horse Breeding, by H. K. Bush-Brown, American Breeders Magazine, Vol. II, Nos. 2 and 3.

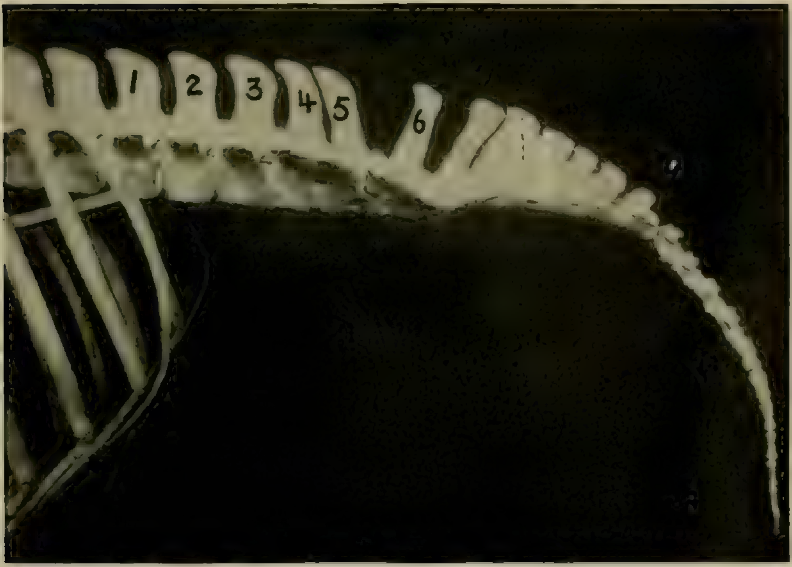
SKELETON OF A PURE ARAB HORSE

Showing the obtuse angle of the head to the line of the neck with "Hogarth's line of beauty" superimposed. This set of the head is recognized by breeders as an essential element of beauty. (Fig. 16.)



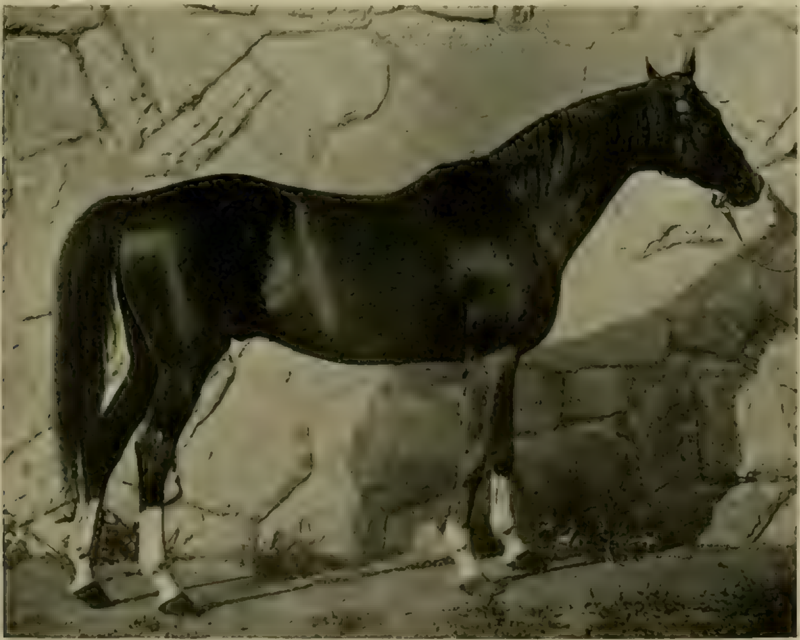
SKELETON OF THE PURE ARAB HORSE "NIME"

The chief difference in the anatomy of the Arab from that of all other horses is that it has but *five* lumbar vertebrae while all other families of the horse have *six*. This difference in structure probably explains why the Arab, though small in size, is capable of carrying great weight and possesses such marvelous endurance. The sire and dam of Nime were only one generation from the desert. The skeleton, reproduced above, is now in the Museum of Natural History, New York. (Fig. 17.)



LUMBAR VERTEBRAE OF "LEXINGTON," THE FAMOUS THOROUGHBRED

The Thoroughbred is a breed of horses descended from the Arab. The skeleton of Lexington, in the National Museum at Washington, shows six lumbar vertebrae. The sixth vertebra inclines backward instead of forward and is reduced in size, and has intermediate characteristics—partly lumbar and partly sacral. This shows an atavistic tendency toward the five vertebrae of the Arab ancestors. (Fig. 18.)



SALVATOR, AN IMPORTED THOROUGHBRED

This racer has a longer back than the Arab. "Hogarth's line of beauty" is shown well in the neck. (Fig. 19.)

THE ASS, LIKE THE ARAB, HAS ONLY FIVE LUMBAR VERTEBRAE

The skeleton reproduced above is that of a hinny whose sire was a stallion with 24 vertebrae (6 lumbar) and whose dam was a jenny with 23 vertebrae (5 lumbar). The fact that this hinny has only five lumbar vertebrae shows the tendency of the dam to dominate the anatomy of the foal in horses. (Fig. 20.)

I am rather insistent on having the dorsal and lumbar vertebrae all counted, not only on account of this Arab specimen in variation from the true type but also because in the Museum of Natural History there is a skeleton of a wild horse of Asia, the Prejevalsky, and also one of a Kiang, each with 19 dorsal and five lumbar vertebrae, making the twenty-four. These are considered merely individual variations, the first lumbar having developed ribs instead of the usual lateral flanges. A superficial observer might class them with the short back of the Arab because of the five lumbars.

Similar individual variation has been found in a work horse and a Shetland pony, each with nineteen dorsals and six lumbars. Also a Grevy Zebra had eighteen dorsals and seven lumbars.

SHORT BACK A RECESSIVE CHARACTER

As the Thoroughbred, which is practically all of Arab blood as his name indicates, never has the short back of the Arab, so far as I know, it seems evident that the short back is not a dominant character. (See Fig. 19.) I have found it to be dominant only in the first generation of outbreeding when the outbreeding is on the male side. That is a pure Arab mare bred to a trotting stallion produced a foal with five lumbar vertebrae (Museum of Natural History specimen).

The weight carrying capacity of the ass has been known for all time and, he, like the Arab horse, has the short back of five lumbar vertebrae.

A jenney or female ass bred to a stallion produced a-hinny which in-

SKELETON OF "OBED"

The sire and dam of Obed (Boaz Clay and Ruth Clay) were each from a pure Arab mare (Naomi) and trotting stallion (Young Jack Shepard). Obed, however, had six instead of five lumbar vertebrae. (Fig. 21.)

herited the five lumbar vertebrae of the dam (see Fig. 20). The sire and dam of Obed were each from a pure Arab mare and trotting stallion, and there seemed a chance that Obed would have five lumbar vertebrae, but he had six (see Fig. 21) with the eighteen dorsals. This shows the recessive character of the short back.

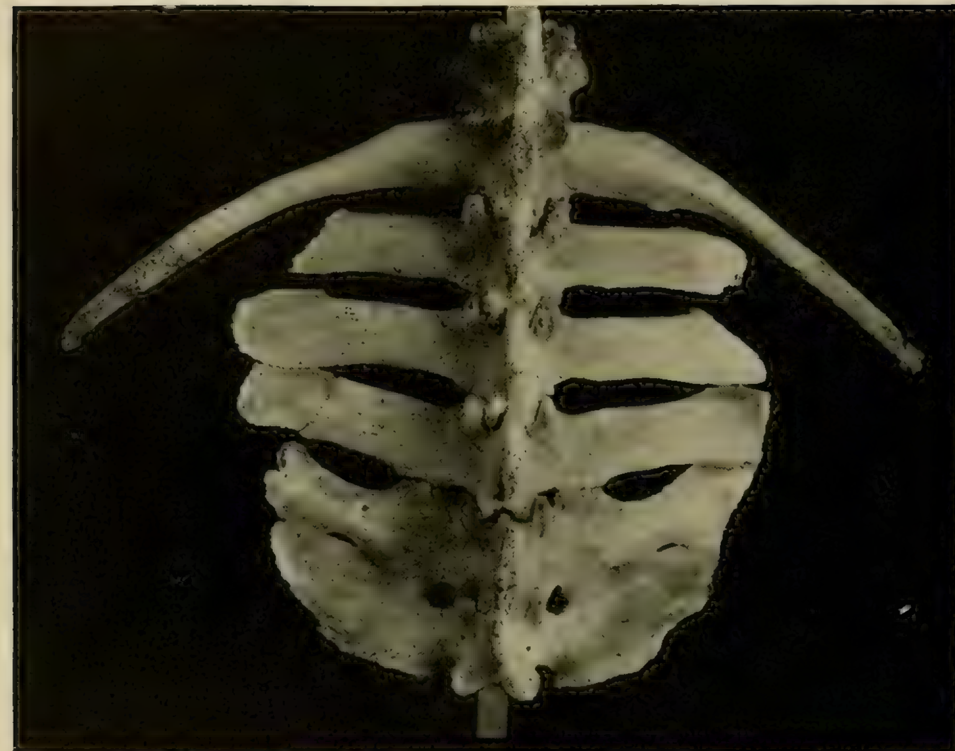
A curious case of atavism is illustrated in the skeleton of McKinney, a trotting stallion, registered number 8818, whose skeleton is in the Museum of Natural History. He was grandson of George Wilkes, and therefore seven generations from the pure Arab Grand Bashaw, his nearest Arab ancestor.

He developed solid ribs on the lateral processes of his first lumbar vertebra. Fig. 22 shows the 17th or last dorsal vertebra, giving his short back of 23 in all, but his solid rib was his 18th, thus having the full 18 ribs. This is important as it explains a like tendency in a foal skeleton from a pure Arab mare and a Norway sire with 17 dorsal and six lumbar vertebrae. (See Figure 23.)

If this foal had lived he would probably have developed two solid ribs like McKinney as he had one rib already attached to his first lumbar, and its mate was probably in process of formation.

McKinney shows by the record that he was a great producer of speed, having sired 31 in the 2:10 class and the dams of 15 in the 2:10 class, while his own record was 2:11¼. His dam was Rose Sprague by Governor Sprague, another great producer.

His anatomy shows he was ribbed up like an Arab with only the width of two fingers between the last rib and the hip



MCKINNEY, A TROTTING STALLION

McKinney was a registered trotting horse No. 8818, seven generations from the pure Arab Grand Bashaw. His skeleton (in the Museum of Natural History, New York) shows the 18th dorsal vertebra and lateral processes of the first lumbar vertebra developed into ribs. (Fig. 22.)

bone. With a saddle on, I believe he could have carried weight and endured long distance. Whether such cases of atavism are common in the trotting horse family I do not know, but in those particular cases they ought to be able to do the work of the Arab. I believe they are very rare. "Nancy Hanks" was apparently of this build.

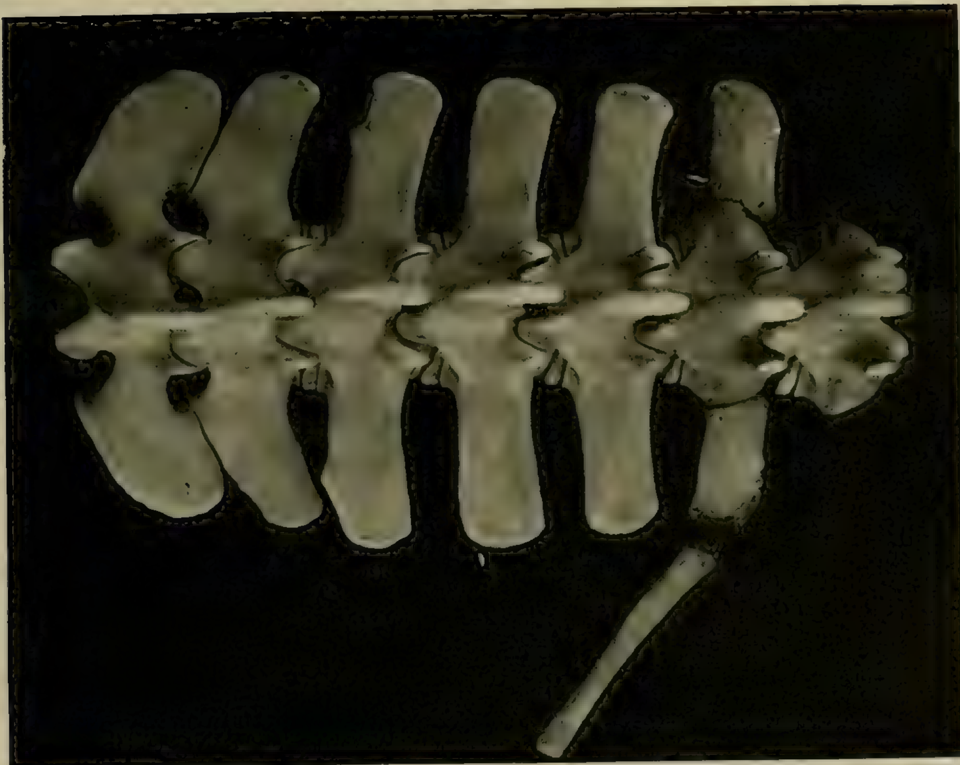
WHY THE ARAB CAN ENDURE LONG TESTS

What do these facts mean to the breeders of horses? Refer to Figures 20 and 23, and one other specimen in the Museum of Natural History. These are three examples of a short back mare being bred to a stallion with 24 vertebrae and the product in each case having the short back of the dam. This seems to indicate the dominance of the dam over the anatomy of the foal.

I think most breeders believe that proportion and anatomy have a relation to speed performance, and if it is so, the above dominance of the dam is borne out by the fact that the successful breeders have paid especial attention to the quality of the dams, and those who have not shown such good judgment have not been successful.

Just why the Arab horse is the best weight carrier among the equines is simply because the bridge of his back is shorter between supports and therefore stronger.

The other anatomical differences mentioned in the first part of this article enable him to carry relatively more food for a long journey and therefore he can endure privation better than a horse who has less "dinner basket" capacity. Consequently it is quite natural for an Arab Horse to win



LUMBAR VERTEBRAE OF A FOAL

A similar tendency to that shown in McKinney in Fig. 7 is illustrated in this skeleton of a foal from a pure Arab mare and a Norway sire. Here is shown the 17th dorsal vertebra and one partly developed rib. The gristle attachment would no doubt have ossified in a short time, and the other floating rib may have been lost in dissecting. (Fig. 23.)

the tests for long distance under service conditions similar to those of the Army, for he is especially built for that purpose.

Since the unit character of a short back seems to be recessive except in the purebred Arab, it quite completely explains why the thoroughbred horse is so different anatomically although he is a product of the Arab by long and intelligent breeding, chiefly from male Arab ancestry.

As his name implies he is "*thoroughbred*" from the Arab and yet in no instance that I know of has he developed the twenty-three vertebrae in the back. Therefore to maintain the Arab type, it must be kept scrupulously pure, and this justifies the custom among the Arabs in tracing their horses' pedigrees through the dam.

Of course the power of transmission of inheritance is not confined to the anatomical structure alone. The Thoroughbred is the best horse for a short distance for which he has been especially developed, and he has courage and intelligence perhaps equal to his Arab ancestry.

LAWS OF HEREDITY SHOULD BE CLOSELY STUDIED

The facts here assembled seem to show that the laws of heredity can be pursued with great advantage by a more thorough study of variability in the anatomy of the horse, especially in outbreeding of the pure Arab with the kindred types of different anatomy—a real field for genetic research. This field needs a policy to be pursued by a group of men who can follow the

"RAMLA," THE FIRST TO FINISH LONG DISTANCE TEST

This pure Arab mare completed the 300 mile test in 1919 from Fort Ethan Allen, Vermont, to Camp Devens, Mass., in 57 hours and 26½ minutes, and received the perfect condition mark of 50, and 92.9% for total performance. (Fig. 24.)

research in a well defined way covering a long period of time, and when the older research workers drop out, new men can follow, and so ultimately bring to light a lot of information that can now be seen only obscurely.

If these facts do indeed lead into a comparatively unexplored field, is it not worth while to go further? I would suggest that each year the fastest running horse and the fastest trotting horse be photographed and measured by the system I showed in an article some years ago in the American Breeders Magazine on the proportion of horses.

Every best producer of speed of both sexes should be similarly subject to study and at intervals, when a famous horse dies, his skeleton be prepared for study.

These separate types of the horse having specific anatomical differences, give the breeder an opportunity to study the relative influence of the dam and the sire on the anatomy of the offspring.

I know of no other family of mammals where a better opportunity exists, and only by the collection of many specimens can the processes of nature be understood.

If we could establish some more laws of heredity in horses they would be applicable to all mammals to a great extent.

The breeding of small animals for genetic research has been more attractive because the generations require less time for results, and for this reason the horse has been much neglected.

"KINGFISHER," SECOND IN LONG DISTANCE TEST

Kingfisher is three-fourths Arab and one-fourth Thoroughbred. He completed the long distance test in 53 hours and 21 minutes and received the condition mark of 48, and 88.8% for total merit. It was this horse that Col. Tompkins of the U. S. Army rode into Mexico in the expedition in 1916, covering a distance of 575 miles over heated deserts and cold mountains. (Fig. 25.)

FUTURE OF THE HORSE

In spite of the general use of the automobile, the horse has a place in the world, though perhaps a less important one. For long distance travel over ground that wheels can not follow and as a safeguard for the future we must preserve the best of the higher types.

The Arab, more than any other horse has the prepotent power to stamp his good qualities on his descendants for many generations.

So long as the supply of gasoline keeps up we can dispense with many uses of the horse, but if for any reason that supply falls below the needs, or is interrupted, the commerce of the world will be in need of horses beyond the capacity to supply, and the world will recover its horses only slowly.

"KHEYRA," A PURE ARAB MARE

Finishing third in the endurance test; her record was 52 hours and 37 minutes, with a condition mark of 25 and a grade of 72.4% for total performance. (Fig. 26.)

Therefore those who preserve the best types we have are saving for the future the means of regeneration which will save mankind from the disaster that would be, if the oil wells fail to supply all the power the world needs.

THE ARMY DISTANCE TEST

The long distance test from Fort Ethan Allen, Vermont to Camp Devens, Mass., a distance of 300 miles, was ridden between Tuesday, October 14, 1919 and the following Sunday, October 19, the horses doing 60 miles a day for five days, with a quarter mile dash on the sixth day to test condition. There were 14 to start and eight to finish, all in good condition—six sound and two slightly lame. Most of the horses starting the test were: eight Arabs, four Morgans, and two grade thoroughbreds. Those finishing were six Arabs and two Morgans.

In the ¼ mile dash on the sixth day to test fitness, the ¾ bred Arab mare Halcyon (Fig. 27) was first, the Arab mare Kheyra (Fig. 26) second, the Arab mare Ramla (Fig. 24) third, the ⅞ Arab Kingfisher (Fig. 25) fourth, a Morgan "Castor" fifth, and the Arab "Crabbet" sixth.

The performance of this mare "Halcyon" in the whole test is most remarkable as she had weaned her colt only a few weeks before and was again in foal. She is the same mare who won second place in the broad jump in the International tournament for cavalry horses held in Madison Square Garden a few years ago, and was the only American horse to take a prize in that event.

Halcyon is the dam of Kingfisher who was placed second in the Endurance test. Kingfisher, it will be remembered, carried Col. Tompkins

"HALCYON," THREE-FOURTHS GRADE ARAB, CROSS-BRED

Halcyon finished fourth in the long distance test; time 53 hours and 45 minutes, condition 50, and total performance 71.3%. She is the dam of "Kingfisher" who finished second. "Her breeding is a good example of the value of selecting dams with careful judgment." (Fig. 27.)

on his forced chase after Villa from March 15 to April 12, 1916, a distance of 575 miles across the heated desert and over the cold mountains of Mexico, carrying his rider with officer's pack and his own grain rations. His forage was what he could get on a tether at night, and he was in good condition for the three hundred miles that followed.

It is worthy of note that the dam of "Halcyon" was "Heiress" ½ Arab and Thoroughbred, under 15 hands, who won the high jump at the Crystal Palace in London in 1897. Her sire was the famous desert bred Arab "Maiden" who was the unbeaten steeple chase horse of India and after twelve years of campaign in Egypt won many flat races in France.

As "Halcyon" is inbred to this stallion, it was to be expected that she would give a good account of herself when put to a long distance test. Her breeding is a good example of the value of selecting dams with careful judgment.

BEST CONCLUSIONS FAVOR ARAB

I have drawn the conclusions which seem to me to be indicated by the facts from all the data available. It may be that there are not sufficient data on which to base conclusions. I have asked for cooperation from breeders

everywhere in assembling more data covering a long period of time.

This long distance test itself, perhaps some may contend, is not conclusive because the trotting horse was not represented and the thoroughbred represented only by some grade animals. Then, let other tests be given and include long backed horses. If they can stand conditions required for carrying weight long distances, we can change the conclusions after that fact has been established.

The Diamond Ranch of Wyoming has for a generation been breeding the long distance thoroughbred horses and they are known very favorably in the army, but none of them have been in these long distance tests. Similarly the Mustang, or western pony, is known for his weight carrying ability and endurance. Can he make good in these tests, and to what extent has he the short back of his Arab ancestors who were brought to this country by the Spaniards?

NATIONAL INTEREST IN HORSE CONTESTS

Ever since the wild horse was domesticated, that is before man had a written history, the racing of horses was one of the sports of man. The trotting horse race was developed by the American people with its distinctive type of horse that has endeared himself to the heart of man and gone conquering all over the world.

The Army Horse Association was organized for the purpose of making a national sport of the long distance horse test. The country has been divided into fifteen zones so as to have a "horse country" with a 300 mile defined course in each zone. The New England horsemen have adopted zone No. 1 and have ridden it two successive years with marked results.

The way to serve our country in time of peace is to make a national sport of the long distance weight carrying horse and to do it with a scientific spirit of finding out the best types without favor to any one type or man's prejudice. Only in this way can we collect the necessary information of what the type is and where and how to produce it.

By making a sport of this kind of racing, the type will result just as the thoroughbred and the trotter are separate types to fill the needs of two kinds of racing.

THE ARMY TEST OF 1920

Since the preceding part of this article was written the endurance ride of 1920 has been concluded and the results seem to have more than justified what has here been said of the Arab horse.

Five racing Thoroughbreds were carefully prepared at great expense for this ride. One was withdrawn the day before the race. Of the four entered, only one finished, and he was eighth, receiving no money reward and had a condition mark of only 25 out of a possible 50. Five grade Thoroughbreds were entered; two were army mounts, and they finished in first and third positions getting 40 and 35 for condition.

Of Arabs and their derivatives, ten started and five finished. Three were among the money winners, getting second, fourth and fifth places, and one was the only horse to have 50 on condition—a perfect mark. Another tied with a Morgan at 45 on condition—the second highest mark. One purebred Arab made the best time for single days on the fourth and fifth days, namely 60 miles in eight hours flat, and eight hours and a little over, not including a noon stop, beating all records for distance and the weight carried. It was also an Arab that came in first on the last day.

TESTS A FIELD OF SPORTSMANSHIP

It was these facts which justified one of the judges in saying that the Arabs could have taken the first place, if they had not been held back by their sportsman owner who, apparently, wished to give other horses a chance, by which means long distance rides will be encouraged as a national sport.

There were two Standard bred horses in the race and they were dropped on the second and third days.

Of the Thoroughbreds that were out of it, there was one on first day, three on the third day and one on the fourth day and one on the fifth day.

The Morgans did a little better. Of the six entered, two finished in sixth and seventh places. Of those that were dropped for fatigue, one was on the third day and three on the fourth day.

The summary is as follows:

STARTING

Thoroughbreds: 5 registered and 5 grades
Arabs: 5 registered and 5 grades
Morgans: 5 registered and 1 grade
Standard bred trotters: 2

FINISHING

5 Arabs and derivatives, 50 percent of starters
3 Thoroughbreds and derivatives, 33 percent of starters
2 Morgans, 33 percent of starters.

Thus it may be seen, that of the 28 to start, ten finished.

This endurance test goes far to justify the statement that breeding race horses for a fast mile does not produce horses for long distance. Endurance requires a type bred for endurance.

One might as well ask a running horse to trot a fast mile or a trotting horse to run a fast mile as to put these horses in an endurance test to carry two hundred and fifty pounds on their backs sixty miles a day for five days.

Let us make a national sport of this type of endurance horse in the interest of better horses for the army and breed an endurance type.

The first, second and third horses in this contest were of the Hunter type which is well recognized, but some breeders claim it is not a reproducing type. If these contests are continued and horses bred for the type demonstrated to be the best, it can be made reproducing just as the Standard trotters are now a reproducing type derived from Thoroughbred foundation.

A NEW GENETICS JOURNAL

HEREDITAS, a new journal for the publication of original researches in genetics, appears in its first issue under the auspices of the Mendelian Society in Lund, Sweden.

H. Nilsson-Ehle, president of the society, has associated with him on the editorial committee Herman Lundborg, Nils Heribert-Nilsson, and Gustav Thulin. The editor of the journal is Robert Larsson, Adelgatan 7, Lund, Sweden.

Papers will be published in either English, French, or German, and it is expected that three numbers of the journal will be issued yearly to make up a volume of 350 pp. The contents of the first issue follow:

H. Nilsson-Ehle: Über Resistenz gegen Heterodera Schachti bei gewissen Gerstensorten, ihre Vererbungsweise und Bedeutung für die Praxis.—H. Lundborg: Hereditary Transmission of Genotypical Deaf-Mutism.—Nils Heribert-Nilsson: Zuwachsgeschwindigkeit der Pollenschläuche und gestörte Mendelzahlen bei Oenothera Lamarckiana (With an English summary).—Hans Tedin: The Inheritance of Flower Colour in Pisum.—Emanuel Bergman: A Family with Hereditary (Genotypical) Tremor.—Hans Rasmuson: Über einige genetische Versuche mit Papaver Rhoeas und Papaver laevigatum.—Å. Åkerman: Speltlike Bud-sports in Common Wheat.—J. Rasmusson: Mendelnde Chlorophyll-Faktoren bei Allium cepa.

THE MENACE OF THE HALF-MAN

Seth K. Humphrey
Boston, Mass.

WHO marries earliest and breeds fastest? Anyone gifted with eyesight and a fair habit of observation knows that, in nine cases out of ten, it is those least capable of providing their offspring with either a heritage of brains or a decent bringing up. The one big fact in the reproductive habits of civilized man is that, in a very general way, the energetic, the brainy, the foreseeing—those who emerge from the commonplace to the level of achievement—have the fewest children, while the improvident and degenerate take as instinctively to reproduction as a duck takes to water, and have altogether too many.

We are populating the earth from the wrong kind of stock. A high English authority asserts that more than half of England's children are produced by the lowest one-sixth of the population; and certainly we in America are doing no better.

Now there is not an intelligent reader of this page who does not know that such a scheme of selection would wreck the quality of any other species of animal or plant. But the mystic teaching of the ages, and our own colossal self-esteem, set us up as a creation just outside the Big Plan. Most of us miss the eternal fact that man is a species, dependent like any other on what he inherits for the qualities which he develops. Meanwhile, Dame Nature is dealing us just the kind of humans that we ought to expect from our manner of producing the most children from the poorer stocks.

THESE FUTURE CITIZENS IN THE SCHOOLS

Suppose we begin at the beginning and follow the output of this system. First, the children appear at the public schools. The public schools used to function badly—they do now in many respects, but they functioned worse before the authorities awoke to the drag imposed on the normal pupils by the growing numbers of the weakminded. So they hit upon the clever scheme of gathering these feebleminded into special classes; experimentally at first, but soon the special class developed into a regular feature of public school work. Now, every sizeable city in the land has its rooms for dullards, in great numbers and rapidly multiplying. Boston alone has seventy-seven rooms in her public schools devoted exclusively to the backward.

We complacently accept the special room as a beneficent device, simply because it permits the schools to run more smoothly. But the special room is mere camouflage thrown over a desperate situation. What sort of citizens can we hope to make of these incompetents?

It seems a harsh thing to say of innocent little boys and girls, but to a very great extent these are society's future jailbirds and prostitutes. Does this jar? An ugly truth usually jars when it crowds against a soothing popular misconception. Proof is to be had, many times over, in the investigations carried on in prisons, reformatories and rescue homes—every one of which has shown from forty to sixty per cent of the inmates to be mentally subnormal. There is a very direct connection between children who cannot develop and grown-ups who cannot behave. This connection is now being brought home with increasing force to every charitable organization which has substituted scientific inquiry for emotional philanthropy.

THE "BORDERLINERS" ESCAPE DETECTION

But the special room is a very small measure of the total number of weakminded children in the public schools.

These youngsters have a way of getting on fairly well with their normal schoolmates until they are near the limit of their mental growth; then they begin to show unmistakable signs of wobbling. A child, for instance, who will never get beyond the mental age of ten can usually manage to keep out of the special room until he is nearly ten years old; it follows, then, that children destined to go through life with mentalities of fourteen or fifteen, get through all the grades and leave school without disclosing their limitations—yet they couldn't have got by a year in the high school to save their lives.

These less obvious of the feebleminded are the "borderliners," or "morons," as they are technically known—men and women in appalling numbers who stumble along through to old age with just enough wit to escape the foolish house and not enough to connect with the social order. Their shiftiness begins with their first job—they bulk large in the great labor "turnover," so disastrous to industry; they qualify more readily for jails and institutions than for steady effort, and naturally take the easier way. Irresponsibility is their outstanding, lifelong characteristic.

THE GROWING DANGER OF THE "HALF-MAN" IN SOCIETY

Ignorance, as a disturber of social peace, is giving way to education; we are righting injustices which cause turmoil; but the Menace of the Halfman is growing almost unchecked. By instinct they follow any and every designing agitator who happens along. For them, life is one round of spiritless work, rebuffs, hardships, failures and futile beginnings over, such as would kill us normals within a few years. This world, as we now manage it, is run for full-made men and women—that's why it is such a difficult place for grown-up children.

And these are essentially grown-up children. It is all very well to dub them facetiously, "I Won't Work"—some of them deserve it; but when will we learn to read the pathetic message stamped as a birthmark on the crooked features of so many more, "I *Can't* Work"? Precious few humans are born with a distinct inclination for crime, but a sorry lot of them are born every day with too meagre brains to make a living in the paths of virtue. Then why be surprised at their readiness to take up with the forces of disorder? We merely expose our crass ignorance of human nature in one of its rapidly growing phases.

And how they do multiply! Next to their irresponsibility, the chief characteristic of these half-equipped humans is their astonishing fecundity. Evidence of this is so thrust upon the senses of every man or woman who knows the improvident that it needs no further elucidation. The common acceptance is that this grade is increasing at about twice the rate of the normal population; this probably is an underestimate. A western city, recently having rounded up nine hundred of its deserters of families—and habitual desertion of family is a common mark of the half-man—discovered that they had abandoned forty-seven hundred children, not to mention those they had left along the trails of their wanderings. This is an average of more than five children each. From observation of human nature in general it is safe to say that nine hundred of the most progressive families in that western city could not muster an average of two children each. Five from the worst stocks, against two from the best—this is a condition that holds in a general way for our whole population.

INCOMPETENTS INCREASE DEMAND ON CHARITY

No wonder that we have had to develop such enormous corrective and philanthropic machinery everywhere. This sort of people is doubling on our hands with every generation. The number of charitable organizations in New York City runs into four figures; they are counted by hundreds in every other large center of population. Charities originally were supposed to

look after the worthy unfortunate, but now, nine-tenths of their effort is with born incompetents. And that is why something like eight-tenths of their effort is practically futile, so far as any permanent reconstruction of these individuals is concerned. With impossible human beings, nothing is possible. Social workers habitually wonder at the proverty of results; if they knew the fundamentals of heredity they would cease to wonder.

THE DETERMINING FORCE OF HEREDITY

All this environmental work, and all education and training of youth, essential as they are, do next to nothing toward eliminating hereditary defects. It is all development work—trimmings, as it were, with which we bedeck the individual for his journey through life—and the trimmings die with him. They do not affect our biological makeup. Education doesn't get into the blood.

The only thing that descends through the generations is the *capacity* to respond to education and training. Heredity furnishes the mechanism—determines the physical and mental quality of the human material with which we have to work. Upon the inherited quality of the child depends the quality of the man we can make of him. A carpenter cannot make a mahogany table out of pine boards; and if we breed in greater numbers from the mentally inferior types, we are going to have an ever increasing proportion of children incapable of being developed into upstanding men and women.

How have we come so far on the way to racial degeneracy without any visible attempt to check ourselves? Mainly because of a pious horror of any action that looks like interference with the right of parenthood. It is a hangover sentiment from the ages of ignorance and superstition which we cannot shake off, in spite of our present clear knowledge that a vicious parenthood is flooding us with a vicious progeny.

THE UNGUARDED SOURCE OF HUMAN MISFITS

Our impotence in this respect looks the more ridiculous when we consider how keen we are to prevent any ill-favored specimens among our plants, pigs and cattle from reproducing their kind. We are up to the minute in guarding the heredity of every other useful species, and back with the Pharaohs in protecting our own.

So we sit helplessly by, with full knowledge of what is happening to us, while any two people not in jail or the lunatic asylum bring children into the world regardless of consequences.

If their children prove to be hopeless misfits, we guide them through the special room, and perhaps to the reformatory. But do we look back to their source with a view to preventing more of their kind? Not at all. We supinely await the further product of their usually worthless parents. Or do we make the slightest attempt, later on, to restrain the fecundity of these children themselves? About one in ten, helplessly imbecile, are segregated in feebleminded institutions; the other nine-tenths are free—except for the periods spent in jails and prisons—to exercise the one sturdy function with which nature seems to have endowed them.

BURDEN OF CORRECTIVE MACHINERY

Of all the relics from the past, this superstitious notion of the inviolability of parenthood is the most expensive—in money, in human misery, in social maladjustments which we must forever be combating. Is the burden of corrective and philanthropic enterprises becoming heavy? It will grow vastly heavier with each succeeding generation. Special rooms, reformatories, asylums, prisons and the present swarm of charities will increase by leaps and bounds, because the sort of humans who cannot be taken care of in any other way is increasing by leaps and bounds.

NEED FOR EDUCATION IN THE LAWS OF HEREDITY

The one and only way to clear the race of its burden of hereditary unfitness is to cut off its reproduction at the source. The first step toward that end is to promote a general understanding that every ill-favored, shiftless, weak-minded delinquent is as unfit for perpetuating the race as is a scrubby, unintelligent, underbred horse to take its place in the breeding stable. Not that we shall ever come to methods approaching those for perfecting domestic breeds; that is as unthinkable as it is unnecessary. Heaven forbid that we should have standardized human beings, even if such were possible. But we *may* entertain the worthy hope that, sometime, we shall have the courage to deny parenthood to those who are manifestly unfit to produce American citizens.

A GOOD ENVIRONMENT NECESSARY

What determines unfitness for parenthood? Eugenists are inclined to put the whole stress on heredity, and to seek too much exactness in applying their scientific knowledge. But common experience should tell us that unfitness for parenthood is not by any means a matter wholly for biological determination. Next to being well born, a child needs a good environment. When we see men and women who are perpetually at odds with the social order, incapable of all ordinary adjustments, we ought to know just as well that they will be wholly unfit to rear children as if we had studied their pedigrees for ten generations back. Control of unfit parenthood can never be reduced to an exact science. The problem demands a copious injection of common sense and every-day experience into the knowledge which biology has given us; it should not be left to the faddist adherents of either heredity or environment. A good quality of both is equally essential.

EXAMINE CHILDREN IN PUBLIC SCHOOLS

But any system for restricting parenthood, to be effective, must not wait for demonstrations of parental unfitness. Bear in mind that irresponsibles, incapable of self-restraint, begin their sex activities years earlier than normal people. The public school is the place for the scrutiny of the nation's future mothers and fathers. It is not too much to say that in the great majority of cases the final determination should be made before the child leaves school, or as soon thereafter as its actions give the further necessary evidence. It is also a safe assertion that most mental defectives who attain their twentieth year unrestrained have added to the race's load of defective children. The need for early action cannot be too strongly emphasized.

TO CHECK INCREASE OF THE UNFIT

How shall we put denial of unfit parenthood into effect? Certainly not by legal enactment against marriage. That would mean nothing to the average incompetent.

Institutional care, perhaps in farm communities, might well be put upon at least five times as many of the obviously defective as are now segregated. But there would still be as many more, of the "borderline" types, for whom segregation would be an unnecessary deprivation of liberty. Sterilization is the usually proposed expedient for such cases. It is something to which the public has yet to be educated, but once it is understood it undoubtedly will have the leading part in any accepted scheme of race regeneration.

Any proposal to suppress unfit parenthood is bound to meet violent opposition. But it will meet none more blindly stubborn than those who hold that proper environment can overcome any adverse effects of heredity. They admit hereditary defects, but would camouflage them with more thorough training of the individual and a bettering of social conditions.

TO MAINTAIN QUALITY OF SPECIES IN WELL-ORDERED COUNTRY SHOULD BE AIM OF SOCIETY

But suppose that, for the moment, we put aside the claims of heredity, and

view our manner of rearing humans from the environmental standpoint alone. The first big fact that we meet —a fact easily demonstrable by anyone who will go from the silent streets of the thrifty to the swarming alleys of the thriftless—is that at least three-quarters of all children are born to living conditions well below those of the average, as measured, not by wealth, but by the quality of the parents,—while a scant one-quarter have the advantage of homes above the average.

Now what enthusiast for the power of environment would deliberately raise most of his flowers and chickens under adverse conditions? Yet this is exactly what we are doing with the human species.

So from the viewpoint of either heredity or environment our method of perpetuating humankind is a complete reversal of nature's scheme for maintaining quality of species. We may be drifting slowly, but we are *drifting*—toward a depreciated race. The histories of Babylon, Egypt, Greece and Rome show us that each, in its turn, went to its final blaze of glory with its population reduced to a vast mass of mediocrity—a huge, incoherent proletariat, ridden by a handful of plutocrats whose culture savors of a splendid degeneracy.

Is such to be our end, generations hence? Nobody knows. All we really know is that we are following the beaten path of the ages. Yet we need not follow it a day longer than we choose. And the first move toward regenerating the race is to cut off unfit parenthood. Rid the race of the half-man, and human misery, in a well-ordered country like America, will be more than cut in half.

Tests of Intelligence and Achievement

Standard Educational Tests, arranged and standardized by M. E. Haggerty, professor of Educational Psychology at the University of Minnesota. Yonkers-on-Hudson, the World Book Co., 1920.

"With the extension of educational investigation it is becoming apparent," says Professor Haggerty in his Manual of Directions accompanying these tests, "that too little attention is being paid to the native intelligence of children. Attention was first directed to the matter through the presence in the schools of a considerable number of mentally defective and in some cases feebleminded children. These children presented serious problems to teachers and forced themselves upon the attention of superintendents and others. The result was the organization of special classes for teaching them and the development of special testing methods for their proper classification.

"More recently attention has been called to the presence in the school of a number of superior children. The number of these is probably as great as that of the backward and feebleminded. The work of Terman, Whipple, and others shows that such pupils can be identified through the use of intelligence tests and that they can with profit to themselves and to others be separated from the regular classes and be taught as a special group."

Professor Haggerty has followed the example of numerous other psychologists in preparing tests suitable for the different grades in school. They are based largely on the army tests.—P. P.

A GRAFT-CHIMERA IN THE APPLE

Evidence That the Two Distinct Types of Fruits on the Same Tree Are Not Due to Bud Sporting or Top-Grafting

A. B. Stout
New York Botanical Garden, New York City

THE accompanying plate illustrates two distinct sorts of fruits borne on an apple tree that has evidently never been top-grafted. The fruit shown at the right is typical of the King variety; the other is nearly identical with the fruits of the Rockbury Russet. The two types of fruit are quite distinct in respect to size, color, character of skin, flavor, and texture, and the leaves of the branches bearing them are noticeably different especially as to size.

The tree which bears these two kinds of foliage and fruits stands in the vicinity of Geneva, N. Y., in an orchard owned by Mr. T. D. Whitney. Mr. Whitney helped plant the tree in 1862, has resided on the place ever since, and has for many years observed the dual nature of the tree.[1]

At the present time the tree is large and well developed and is about 30 feet in height and in spread. Most branches bear the Russet fruits. About 20 of the smaller branches bear King fruits and these branches are well scattered, being found among the tip branches of all of the large main divisions of the trunk.

EVIDENCE OF THIS AS A CHIMERA

The occurrence of two more or less distinct kinds of fruit on the same tree may be due to any one of three causes, as follows: (1) vegetative variation or bud sporting, (2) the usual consequence of top-grafting, or (3) an unusual and somewhat indirect result of grafting, which gives a plant in which the two kinds of cells belonging to stock and scion become associated together in the same branches, giving what is now known as a chimera.

Dr. U. P. Hedrick, of the Geneva Experiment Station, is convinced that bud sporting has not occurred in the tree in question. He does not consider it probable that these two types of fruit which differ so widely in several characters can be so closely related as to be parent stock and bud sport.

Mr. Whitney is positive that the tree was never top-grafted. His continuous association with the orchard from the time of its planting to date, his wide knowledge of apples, and his definite recollection of this particular tree make this point seem certain. The scattering branches which bear King fruits have not grown from King scions that were grafted to branches of a Russet tree.

CHIMERAL FRUITS FOUND

Very definite evidence that the King branches are not simple top-grafts is also seen in the chimeral fruits which are sometimes found. Such fruits have a segment that is King while the rest are Russet. These show that the two cells of the King and Russet varieties are associated together in single twigs, leaves and fruits. Such a combination has thus far not been produced as a direct result of grafting but chimeras of this class or rank very frequently occur in bud sports, they have now been produced experimentally, and they have also arisen incidentally as indirect products of grafting, giving what has frequently been called "mixed plants."

Several cases of "mixed plants" have long been known to horticulturists and for many years these plants aroused much discussion as to their origin and nature. One of these is the Bizzaria or-

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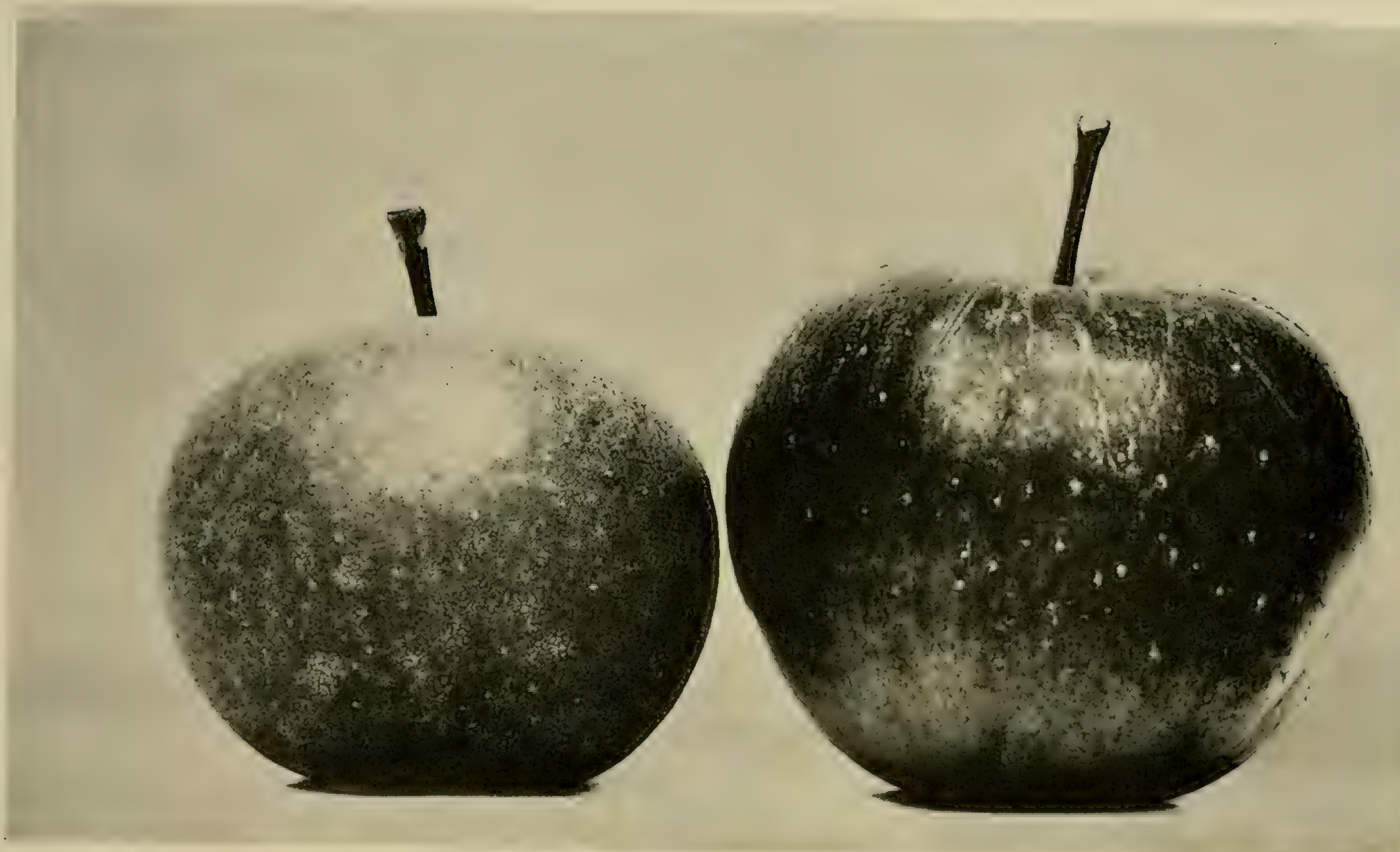
[1] The writer recently had the pleasure of visiting this interesting tree together with Dr. U. P. Hedrick, Mr. O. M. Taylor, and Mr. W. O. Gloyer, of the staff of the New York Experiment Station, all of whom shared in the observations recorded here.



TWO VARIETIES OF FRUITS ON THE SAME TREE

An interesting case of a graft-chimera in the apple is shown in these two distinct sorts of fruits produced by the same tree. The fruit at the right is of the King variety, and the one at the left is a Russet. The tree bearing these fruits has two different kinds of foliage well scattered throughout the branches. The fruits differ distinctly in size, color, flavor and texture. Enlarged about one-fourth. (Fig. 128.)

ange which appeared in Florence, Italy about 1644. On some of its branches oranges are produced, on others citrons develop, and on other branches the fruits are part orange and part citron as shown on page 522 of Vol. 5 of this Journal (December, 1914). Another plant known as *Cytisus Adami* originated in 1825 as a branch of a plant grown from a graft between *Cytisus purpureus* and *Laburnum vulgare.* Some branches of this plant are pure *Cytisus purpureus*, others are pure *Laburnum vulgare*, others are various mixtures of the two, and others bear leaves that are intermediate in character. Several types of plants are known which appear to be mixtures of the two species *Crataegus monogyna* and *Mespilus germanica.* All of these have been propagated vegetatively and have been objects of more than usual interest. How these plants originated has been a matter of no little discussion and speculation among botanists and horticulturists.

GRAFTING TO PRODUCE CHIMERAS

The experimental production of chimeras in rather recent years has shown very clearly how such plants can arise incidentally through the practice of grafting. By a simple but ingenious arise incidentally through practice of grafting. By a simple but ingenious method of experimentation Dr. Winkler, now Director of the Botanical Garden at Hamburg, produced such plants under observation and control. He used the tomato and nightshade, two distinct and well-known species with marked differences in leaves, flowers and fruit. He made grafts, and when the scions were well established he decapitated the branches by cutting through the points of contact between scion and stock, thus exposing on the cut surface the two kinds of tissue and the lines of contact between them. On this surface a callus formed from which buds arose. If a bud arose entirely from the part that was nightshade the branch was nightshade only; if from tomato tissue the branch was pure tomato. If, however, a branch arose over the line of juncture it was composed partly of tomato and partly of nightshade tissue.

TWO KINDS OF CELLS IN SAME BRANCH

Such branches were called "chimeras." The simpler of these show vertical lines of differentiation; one sector bears the leaves, flowers, and fruits of the tomato while the rest of the branch bears those of the nightshade. Such branches and the plants grown from them by vegetative propagation are called "sectoral chimeras." In such an association of two kinds of cells, each sort retains its own character and the leaves, flowers, and fruits of the two sectors are readily to be identified.

Occasionally, however, branches arose which produced leaves, flowers and fruits that were intermediate or mixed in character. One of these (named *Solanum tubingense*) bears simple leaves like the nightshade but the leaves are more or less lobed and are hairy as the tomato. Another (*Solanum proteus*) resembles the tomato more than the nightshade; the stems and leaves are hairy but the fruits are smaller than those of the tomato. Several types of intermediates were produced and for a time it was believed that these were true graft-hybrids resulting from the actual fusion of certain vegetative cells of the tomato and the nightshade in the region of contact in the graft. Later, however, a study of the internal and minute structure of the cells in these plants revealed that the two kinds of cells characteristic of the tomato and the nightshade are both present, and that one kind exists as one or more continuous layers covering the other kind. It was found that *Solanum tubingense* has one outside or periclinal layer of tomato cells covering a core of nightshade tissue and that *S. proteus* has two such periclinal layers. Other types of the intermediates have one or more outermost layers of nightshade cells covering tissue of the tomato. The plants were thus found to be periclinal chimeras. A photo of four

of these intermediates or periclinal chimeras is shown in *The Journal of Heredity*, Vol. 5, No. 12, and an excellent discussion of how such chimeras are produced is there given.

Similar study of *Cytisus Adami* and the *Crataegus-Mespilus* so-called graft-hybrids showed that they are also periclinal chimeras with one or more cell-layers of one species covering a body of cells of the other species.

INTERACTION OF DIFFERENT KINDS OF CELLS

The rather intimate association of the cells of two different species in the same stem, leaf, flower, and fruit is especially interesting in view of the mutual interactions, mechanical and physiological, that may occur. The evidence indicates that the two kinds of cells remain independent in respect to their own hereditary characteristics, but in the periclinal chimera they interact producing organs that are intermediate in character. Slight differences in the arrangement of the same two kinds of cells also produces vegetative and floral s ructures and fruits that are quite different in appearance.

While the investigations indicate that the supposed graft-hybrids are in nature only periclinal chimeras, the production of true graft-hybrid through a fusion of vegetative cells is still to be considered possible. In fact Dr. Winkler has presented evidence that this is the case in one adventitious branch that arose from a decapitated graft between the tomato and the nightshade.

The production of sectoral and periclinal chimeras by experimenal means readily shows how such branches can arise incidentally on plants grafted by the ordinary methods. New and adventitious buds may arise from the region of union between stock and scion, especially if the upper part of the scion dies. If such a bud arises over the line of contact it may develop as a chimera. Dr. Winkler's studies show that sectoral associations develop more frequently than do the periclinal.

CHIMERAS THROUGH BUD SPORTING

It should be noted that intra-varietal sectoral and periclinal chimeras frequently arise through bud sporting. Such partial bud sports have been described frequently in the pages of this journal, especially for such conspicuous cases as the loss of green color which is carried on into various new branches.

Some of the albomarginate types of variegated plants (of *Pelargonium* for example) are clearly periclinal associations of green and white cells all of which belong to the particular variety. In the original sport, most probably, a single cell lost the ability to produce the green pigment and this cell was so placed in the growing point that its multiplication by division gave one or more layers of white cells. Once established the relative position of the white and the green cells was maintained rather uniformly in the subsequent development of branches.

It is also to be noted that, in many sorts of variegated plants, though the pattern strongly simulates a chimeral arrangement, it is really due to physiological conditions affecting development of color in the leaf as a whole. In these the colored and colorless areas often cut across cell layers or histogens. Much remains to be learned regarding the development of such local areas of infectious chlorosis, as well as the development of various patterns of anthocyanin coloration in flowers and foliage.

PROBABLE ORIGIN OF THIS CHIMERA

Mr. Whitney's tree bearing Russet and King fruits is evidently a chimera that has grown from a bud that arose on the line of contact between scion and stock, and is hence to be considered as a graft-chimera. Presumably a scion of King was grafted to the root of a seedling of the Russet in the method of ordinary nursery practice. At any rate the tree is clearly an inter-varietal chimera: some branches are composed of sectors of tissue of two varieties; lateral branches arising from

the sector of King are pure for King; those arising from the part that is Russet are pure for that variety, and those that happen to arise from the line of contact continue to be sectoral chimeras. It is possible that in some of the branches the two kinds of tissue are in periclinal relationship and that some fruits possess a skin of one variety and a core or body of the other. Rather careful examination of a large number of fruits by one competent to judge the flavor would be necessary to determine this point.

A French Student of the Birth-Rate

La Natalité, par Gaston Rageot, professéur agrégé de philosophie. Pp. 296, prix f. 5.75. Paris, Bibliotheque de philosophie scientifique, Ernest Flammarion, editeur, 1918.

After discussing with clarity and relentless logic the various conceptions of the population problem that are current, Professor Rageot outlines ways in which he believes the French birth-rate can be increased. They are mostly in the direction of making family life a more prized privilege, either by education (creation of public sentiment), economic changes (e.g., inheritance of land), or political changes (less military service for fathers, extension of suffrage to women), and the like. While the constructive proposals contain nothing particularly new, the book as a whole is one of the most brilliant and penetrating studies of the birth-rate that has ever been published.—P. P.

Eugenics Made Easy

The Racial Prospect, by Seth K. Humphrey. Pp. 261, price $2. New York, Charles Scribner's Sons, 1920.

Mr. Humphrey has rewritten his book "Mankind," reviewed in the *Journal of Heredity* in November, 1917, and has made of it an unusually successful presentation of the essentials of eugenics in the simplest terms. He offers no statistics, no pedigree-charts; instead he gives his readers the elementary, yet vigorous and epigrammatic kind of writing that one expects to find in a newspaper editorial. It is a difficult job to do well, but on the whole Mr. Humphrey has done it well; and it is worth while to have the problems of eugenics stated, for once at least, in kindergarten form.

The author realizes that mere statement of the problem will not solve it; but his own solution is not up to the level of the rest of the book. In the last chapter he takes a look forward to the time when the lower 5% of the population will be segregated or sterilized, while the hundreds of thousands of superior celibate women will become mothers by virtue of a state-organized system of artificial insemination. This sort of patent-medicine cure for the ills of society is not what will make eugenics prevail, and it is a pity that Mr. Humphrey, realist as he is, can not appreciate that human progress does not come by such simple expedients. The eugenic welfare of a nation is bound up with almost every manifestation of the nation's activity; and by hurdling over this fact Mr. Humphrey has fallen short of producing a book that could be commended without reservations.—P. P.

BREEDING EARLESS SHEEP

E. G. Ritzman

N. H. Agricultural Experiment Station, Durham

FOUR years ago the writer reported[1] a rather clear cut case of a simple Mendelian unit character governing the transmission of ear length in sheep.

The following extract from that article will explain the traits differentiating the unlike parental ear types.

> Short ears as referred to here are of a distinctive type with nearly straight lines running from the base and forming an abrupt sharp point. They are also somewhat thicker than the ordinary type of ear. The longest of these ears so far observed in a mature animal measure 7 cm. (2¾ inches). Since no intermediate types either as to length, shape, or thickness have so far appeared, length as a character forms quite a distinctive contrast between this type and that of Rambouillet ears, which measure about 11.5 cm. (4½ inches); Southdowns, which measure about 9.5 cm. (3¾ inches); and Shropshires and native, which measure about 10 cm. (4 inches). In fact, all ordinary ear lengths observed among various breeds and types seem to run close around 10 cm. (4 inches).
>
> The results of the matings as shown by diagram were such that the short ear trait was accepted as a gametically pure parental unit character. S indicates short ear; L, long ear; offspring grouped one above the other indicate twins:

First Cross

Recessive × Dominant or Simplex		♂ 3L × ♀ 69S	Matings	3
F_1 Offspring		♀ 127S + ♀ 222S + ♀ 254S	Offspring	3S

Back Cross

Recessive × Simplex	♂ 3L × ♀ 127S	♂ 361L × ♀ 127S	Matings	3
Offspring	♂ 255L + ♀ 313S ♀ 256S ♀ 314S	♀ 459L ♀ 460L	Offspring	3S–3L

Back Cross

Extracted Recessive × Simplex		♂ 255L × ♀ 127S	Matings	1
Offspring		♂ 422S ♂ 423L	Offspring	1S–1L

$F_1 \times F_1$

Simplex × Simplex	♂ 422S × ♀ 256S	♂ 422S × ♀ 127S	Matings	3
Offspring	♀ 573S + ♀ 461S ♀ 462L	♀ 572S	Offspring	3S–1L

Although but a few individuals possessing the short ear trait had been bred, the result of the matings was so clear cut that further breeding was discontinued.

Incidentally, however, the short ear trait was reintroduced through a ram, No. 632, who was a son of No. 422 by a long-eared ewe.[2] This ram was secured for the purpose of introducing a high twin potency into a flock of seven long-eared ewes kept for a study of this problem.

These matings and offspring are shown in the following diagram (S indicating short ear, L, long ear):

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[1] Ritzman, E. G. Mendelism of Short Ears in Sheep; Journ. Agrl. Research, Vol. VI, No. 20, August 14, 1916.

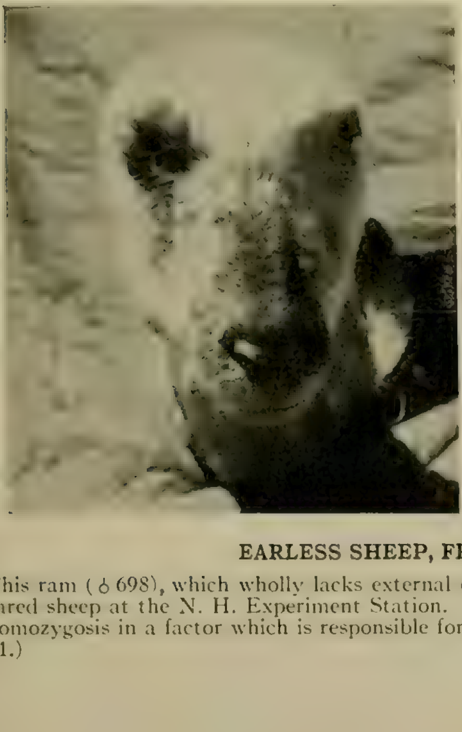
[2] No. 632 was bred by Dr. C. B. Davenport of the Station for Experimental Evolution.

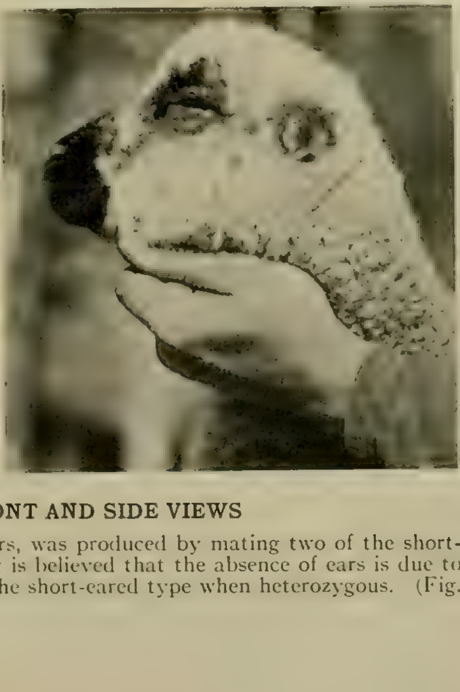
(Fig. 29.)

(Fig. 30.)

ORDINARY LONG-EARED SHEEP AND SHORT-EARED VARIATION

The ram at the left (♂ 3L) has ears of the usual length. The ewe at the right (♀ 127) shows a short-eared type which appeared as a mutation. This variation has behaved as an imperfectly dominant unit character since its appearance. The homozygous form is illustrated by the wholly earless sheep shown below.





EARLESS SHEEP, FRONT AND SIDE VIEWS

This ram (♂ 698), which wholly lacks external ears, was produced by mating two of the short-eared sheep at the N. H. Experiment Station. It is believed that the absence of ears is due to homozygosis in a factor which is responsible for the short-eared type when heterozygous. (Fig. 31.)

Back Cross

Simplex × Recessive	♂ 632S × (♀ 106L + ♀ 486L + ♀ 501L + ♀ 559L		
Offspring (1917 crop)	♂ 650S + ♀ 651S + ♂ 652L + ♂ 654L ♂ 653L	=	Matings 7
Simplex × Recessive	♂ 632S × (♀ 611L + ♀ 623L + ♀ 624L		Offspring 5S–3L
Offspring (1917 crop)	♂ 655S + ♂ 656S + ♀ 657S		

The result of these matings was five short and three long-eared individuals, the former being simplex and the latter pure recessive since they were derived from a simplex x recessive back cross. The following year, ram No. 650, a simplex offspring, was bred to the same list of ewes with the exception that ewe No. 616 replaced ewe No. 106, both pure recessives, with the result shown diagrammatically as follows:

Back Cross

Simplex × Recessive	♂ 650S × (♀ 486L + ♀ 501L + ♀ 559L + ♀ 611L		
Offspring (1918 crop)	♂ 658S + ♂ 659L + ♀ 661L + ♀ 662S ♂ 660S ♀ 663S	=	Matings 7
Simplex × Recessive	♂ 650S × (♀ 623L + ♀ 624L + ♀ 616L		Offspring 4S–6L
Offspring (1918 crop)	♀ 664L + ♂ 665L + ♂ 666L ♀ 667L		

As the character of the matings again represented a back cross of simplex x recessive the result was quite similar as, in the preceding year, and in fact the two seasons' crop, gave exactly the theoretical proportion to be expected from such a cross, namely, 9S + 9L.

The following year, No. 650 was bred to four ewes only. Three of these (486, 501, and 550), being pure recessives, dropped four offspring, two short and two long eared lambs, which again maintained the proportions of a simplex x recessive cross.

SIMPLEX CHARACTER ESTABLISHED

Out of a total of 32 offspring (including two out of No. 127 not shown in diagram) derived from a simplex x recessive cross, 16 were short ear and 16 long ear. This remarkable agreement of results obtained actually with results expected theoretically establishes beyond doubt the simplex character.

The interesting feature, however, developed from the mating between this simplex ram and ewe No. 651 which was also a simplex, corresponding, therefore, to a mating inter se of F_1 the result being a ram lamb No. 698 which had no ears.

EARLESS TYPE A PURE DOMINANT

Only four offspring from simplex x simplex matings had been obtained before and these gave the proportion 3S:1L. While the short ear was formerly accepted as the somatic expression of the pure dominant and of the heterozygote, assuming complete dominance, it now seems clear that the pure dominant is somatically earless and the heterozygote, showing only imperfect dominance, is short eared. In other words, if a single dose for repressing ear length is present the ear is approximately half normal length but if two such doses come together the ear is entirely eliminated.

In this we have a clear-cut case of a heterozygous combination that can be easily distinguished from the homozygous dominants and recessives, and it forms a rather striking example of the "presence and absence hypothesis" of Correns,[3] Bateson,[4] and Hurst.[5]

[3] Correns, C. 1912, Die Neuen Vererbungsgesetze. Gebruder Borntraeger, Berlin.
[4] Bateson, W. 1909. Mendel's Law of Heredity. Cambridge University Press, Cambridge.
[5] Hurst, C. C. Experiments with Poultry. Rep. Evol. Committee Roy. Soc. 1905, II. p. 131.
[6] Hurst, C. C. Experimental Studies on Heredity in Rabbits. Linn. Soc. Journ. Zool. 1905, xxix. p. 283.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

VOL. XI, NO. 6 JULY-AUGUST, 1920

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The Journal of Heredity is published by the American Genetic Association for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $3.00, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $3.00 a year, foreign postage extra; price of single copies, 25 cents.

Date of issue of this number, February 5, 1921

"IN THE VELVET"

A trio of reindeer summer brousing. This remarkable photograph was taken within a few miles of Cape Prince of Wales, Alaska, the westernmost extremity of the North American continent. While the antlers are growing they are said to be "in the velvet," because of the soft membrane and velvety fur in which they are enclosed. An authority estimates that Alaska can sustain a population of 100,000 people with 2,000,000 head of reindeer. Note the "swallow fork," a slit in the ear of the middle reindeer which is an ownership mark. Photograph by Lomen Bros., Nome, Alaska. (Frontispiece.)

THE REINDEER INDUSTRY IN ALASKA

In a Region Not Favorable to the Introduction of Cattle and Sheep, a Great Domestic Animal Industry is Being Built with Reindeer, Furnishing Food, Clothing and Labor to the People of the Far North

G. J. Lomen, LL.B.
Nome, Alaska

OUR national holiday, July 4th, 1892, auspiciously marked the beginning of the reindeer industry in Alaska. On that day, and for ten years thereafter, domestic reindeer to the total number of 1280 were imported by the Government, all of them from Siberia. Those imported from Norway were not breeders. The former were primarily imported for the relief and industrial education of the natives, the Eskimos; the latter were intended for the relief of starving miners at Circle City.

These imported reindeer have increased and multiplied most satisfactorily. From the small beginning above mentioned, they now number at least 200,000, notwithstanding the fact that about 100,000 have been killed for food and skins. At the present ratio of increase Alaska should have 10,000,000 reindeer in less than twenty years.

The ownership of the domestic reindeer of Alaska is held in the following proportions: About one thousand Eskimos own seventy percent; Lomen & Company (Inc.), ten percent; the Government, four percent; Missions, Lapps and others, sixteen percent. The ownership is designated by various earmarks. The general supervision of the industry, so far as the natives are concerned, lies with the Bureau of Education.

THE REINDEER'S CHARACTERISTICS AND HABITS

A brief review of the present status of the industry and a description of the species, the habits and characteristics of the animal will, it is hoped, be of interest to the readers of *The Journal of Heredity*.

Until recently the reindeer industry has attracted but little attention, and little is known of the animal except in the far North; and yet the reindeer is the most widely distributed mammal in the world. Its habitat is circumpolar, embracing the tundras or barrens of the far North, and to a large extent the wooded districts farther south—a territory far exceeding in size all of Europe. Fossil remains show that the reindeer were once indigenous to latitudes farther south than at present.

The reindeer is the only member of the deer family that has been domesticated. This domestication, however, is limited in degree as compared with that of our other domestic animals. The reindeer remain in a semi-wild state, except those that are especially and more thoroughly tamed and trained for sled, draft or lead deer. To catch the animal it is generally necessary to use the lasso. Corrals and shutes are also used for this purpose, especially in the "marking season."

The caribou, the wild reindeer of North America, was never domesticated. An effort to domesticate them will, no doubt, be made in the near future; at least an effort will be made to cross them with domestic reindeer.

LITTLE CARE NECESSARY

Unlike other domestic animals the reindeer does not depend on man for food or shelter. In winter the reindeer feeds almost exclusively on mosses, especially the reindeer moss, *Cladonia rangiferina*, the nutritive qualities of

A HERD OF REINDEER IN MID-WINTER

There are more than a hundred herds of reindeer in Alaska, and they vary in size from a few hundred animals to upwards of 10,000, occupying the west coast from Point Barrow to the Alaskan Peninsula. Reindeer were first introduced into Alaska from Siberia and Lapland in 1892. They have increased from a herd of 171 to nearly 200,000 at the present time, and it is estimated that there is a grazing area sufficient to take care of 10,000,000 of them. The animals can stand the severest weather, and depend upon grazing for all their food. Photograph by Lomen Bros. (Fig. 1.)

CORRALLED AT GOLOVIN, ALASKA

The animals are corralled for the purpose of marking the fawns with an ownership mark. The modern method is to pass them through shutes or runways, thus eliminating the use of the lasso. The reindeer furnish the basis for a new industry which can easily supply Alaska with all the meat it needs besides great quantities for the United States. There has been much inbreeding among scrubby stock, but efforts will henceforth be directed toward improving the grade of the animals by crossing them with native caribou. Photograph by Lomen Bros. (Fig. 2.)

REINDEER FIND THEIR OWN FOOD

They live in the summer time on the moss and other vegetation on the Arctic plains and in winter paw through the snow to get the vegetation that is not exposed. The animal shown in the center is a female reindeer, one of the last of the original stock imported from Siberia. The photograph, by Lomen Bros., was taken near Kruzamapa Hot Springs. (Fig. 3.)

which depend chiefly on the gelatigenous and starchy matter of which it is largely composed. Its taste is slightly pungent and acrid. It is said, also, to contain tonic qualities. It is gray in color, and is the most common vegetation in the far North. In form it resembles branched coral. Other mosses constituting winter foods are: *Cetraria nivalis*, *Stereocaulon paschale*, *Cetraria islandica*, *Parmelia encausta*, *Parmelia saxatelia*. In spring and summer the reindeer feeds on grasses, willow leaves, buds, mushrooms, marine algae. These may be enumerated as: *Aira flexuosa*, *Aira alpina*, *Poa alpina*, *Salix hastata*, *Salix glauca*, *Salix herbacea*, *Menyanthes trifoliata*, *Mulgedium alpinum*, *Rumex acetosa*, *Oxsyria reniformis*, *Gentiana purpurea*, *Ranunculus glacialis*, *Dryas octopetala*, *Rubus chamaemorus*, the *Gyrophora species*, *Nefroma arcticum*, and grasses. Moss is also eaten, to some extent, in summer, but not when dry. In the fall the mushroom (*Boletus*, *Lycoperdon*, etc.) especially attract the animal. To raise reindeer on other vegetation or fodder would necessarily be experimental.

The reindeer is an antlered, herbivorous, graminivorous, ruminant ungulate, and a semi-migratory but gregarious animal, of the family *Cervidae*, the genus *Rangifer*, and the species *Rangifer tarandus*, which latter represents the type. Sub-species, depending on environment, have also been classified.

SIGNIFICANCE OF THE ANTLERS

A full grown reindeer, three years old, stands about four and one-half feet high, and is about seven feet long from its nose to its tail.

The branched appendages to the skull of the reindeer, called antlers, though not as large or heavy as those of some other members of the deer family, are very large in proportion to the size of the animal—literally and figuratively its most outstanding feature. The beams of the antlers are

A CROSS BETWEEN A REINDEER AND NATIVE CARIBOU

It is a pleasure for the natives to drive the reindeer, especially in racing. A span of these animals is said to have made ten miles in twenty-eight minutes. The animal here shown was photographed at the start of a ten mile race. It is fifteen years of age, and is a cross between a reindeer and an Alaskan caribou—one of the finest specimens to be seen in the north country for size and symmetry of body. This illustrates the great possibilities for improving the animals by crossing with the caribou. Photograph by Lomen Bros. (Fig. 4.)

not altogether round, but partially flattened; in places they are nearly three cornered. The beams curve upwards and forwards and are surmounted with slightly palmated tines or prongs. They are supplied with brow as well as beztines. The antlers consist of nearly homogeneous tissue, lighter and more porous than ordinary bone. During their growth the antlers are enclosed in a soft membrane, which is covered with a velvety fur; they are, then, said to be "in the velvet." This membrane consists of a net-work of blood vessels which supply nutriment to the antlers. The antlers are claimed to be secondary "sexual characters." When the velvet has peeled off, in the months of September and October, the antlers are full grown. Then it is that mating time—the rut—begins. The reindeer are unique in that the antlers are common to both sexes, though slightly smaller in the female. The antlers are shed annually, grown up males shedding theirs before the fawning season, the females after that time, and then the fawns. This is providential and enables the weaker to protect themselves against the stronger, during the nurture of the young. The antlers are a protection, also, to the eyes of the animal during their duels, and when racing through underbrush. It is doubtful if dehorning would prove advantageous, but experiments are being made. The size, form and condition of the antlers determine the

REINDEER RACING IS AN ALASKAN SPORT

For exhibition purposes as many as ten reindeer have been driven to one sled, but usually one or two to a sled. Some remarkable records with one and two animals have been made for distances up to ten miles. There is a record of five miles in 14 minutes and 32 seconds, and one for 10 miles in 27 minutes and 30 seconds. Photograph by Lomen Bros. (Fig. 5.)

condition of the animal. Small antlers are a sign of deterioration. Sterile animals are said to be recognized by their straight antlers.

FEMALES NEVER KILLED FOR MARKET

The male reindeer is polygamous. During the rut he gathers his harem—this is a time of love and hate. The bucks then fight duels, often to death. The clatter of horns is continually heard. The antlers sometimes, but very rarely, become so interlocked that the animals cannot separate themselves. If help does not then arrive they will die of starvation.

The reindeer are not particularly prolific. The doe gives birth to one fawn each year—rarely two. Strong and early fawns sometimes breed when only one year old. The does continue to breed until fourteen or fifteen years of age. The reason for the rapid increase of the herds in Alaska is that females are never intentionally killed. The natives are prohibited from so doing, and other owners sufficiently appreciate the value of the does for breeding purposes, not to kill them. Bucks and steers, however, are killed for the market. Their elimination from the herds gives the does and fawns more latitude, less molestation, and more and better feed than they would otherwise have. The period of gestation is seven months and seven days. The herds should double every three years, allowing an annual kill of ten percent, without affecting such result.

VARIATIONS IN COLOR

The color of reindeer in summer is a chocolate brown; in winter it is lighter. Some reindeer are spotted, and some are white. None are wholly of one color. Their hair under the throat, belly, short stubby tail, on the muzzle and immediately above the hoofs, is white or nearly so. Under the throat the hair is very long and tufted, hanging like a pendant mane. The hair of the reindeer is hollow and hence very buoyant.

One of the peculiarities of the reindeer is that it has no gall-bladder. This, however, is said to be common to all of the *Cervidae*. Other peculiarities are that the animal, when running, pants like a dog. Instinctively it travels against the wind; and, in "milling" runs or swims "against the sun." The so-called "dew-claws" of the reindeer are functional—being of use to the animal as a brake in going down snow clad hills, and they assist in supporting the animal on the deep snow

A NEW ARRIVAL

This little reindeer fawn is less than one day old. The doe gives birth to one fawn each year, rarely two, and continues to breed until fourteen or fifteen years of age. Females are never intentionally killed for the market, the bucks and steers being taken for that purpose. Photograph by Lomen Bros. (Fig. 6.)

A WHITE REINDEER FAWN

A cold reception usually awaits the reindeer fawn as the season of fawning opens early in April and extends through May. Fawns like this are often born in the snow with the temperature sometimes as low as 35° below zero. Photograph by Lomen Bros. (Fig. 7.)

and soft mossy tundras where it frequents. The hoofs proper, on account of the great spread of the toes, further assist to support it.

The olfactory powers of the animal enable it to detect the mosses on which it feeds, however much buried under the snow; and its strong legs and sharp hoofs enable it to uncover the food.

THE REINDEER'S HOMING INSTINCT

The animal's power of orientation is remarkable. It *knows* its pastures and its range, its home, and, like a homing pigeon, while it does not fly, "treks" back to its range when removed therefrom, unless restrained by watchful herding, or, until it becomes familiar with its new environments—acclimated, so to speak. The latter takes a year or more.

When walking the reindeer produces a peculiar crackling sound, occasioned by sinews just above the fetlock. Many have ascribed this sound to the clicking of the toes of the animal; others, to a small bone above the quick of the hoof. This sound, as well as an oily substance that exudes from a gland between the toes of the animal, are thought to be a system of sound and scent signals. The Lapps claim that the reindeer "oils its horns" with the exudations of the gland and can "shape the antlers." It is indeed often seen to rub its horns with one of its hind hoofs. This is, however, probably due to an itching sensation produced by developing tines, and not an oiling or shaping process.

The call of the reindeer is a peculiar grunt or bark, difficult to represent orthoepically; perhaps "uhrrr," pronounced gutturally and with a quick expulsion of the breath, would answer. This call is continually heard in a large herd while the fawns are young—the mother calling the fawn or vice-versa. It is also heard when the buck is calling or belling the doe.

The pelage of the reindeer is such as to protect the animal from freezing in the most inclement weather or cold. However, sudden and extreme cold, after a rain, or after a thaw, is a severe test, and is often disastrous, especially to the young animals. Such weather conditions often cause the starvation of large numbers, because of the icy coating and crust it produces, encasing or covering the mosses.

WIDE NATURAL RANGE NECESSARY

On account of the apparent necessity for a change of food, and to avoid the fly and mosquito pests, the reindeer, in summer, seek new pastures, preferably the sea shore, but also high altitudes. They also seek sheltered fawning places. In feeding they travel long distances, nibbling as they go. Thus, their natural range necessarily becomes extensive. Close herding, too, is detrimental to the animal and to the pasturage.

SCIENTIFIC BREEDING EXPERIMENTS TO BE UNDERTAKEN

The reindeer of Alaska have suffered somewhat from inbreeding, due to the difficulties of supplying new blood. Now, that Congress has appropriated funds for the establishment (by the Bureau of Biological Survey, Dr. E. W. Nelson, Chief) of an Experimental Station at or near Unalakleet, Alaska, it is hoped that this difficulty will, in part, be overcome by the crossing of reindeer with caribou, importation of new stock and an interchange of bucks among the herds. It is also hoped that greater attention will be directed toward relieving the animals of disease and pests that afflict or infest them, and that measures will be taken to cause the extermination or control of predatory animals that kill or injure them. These are especially bears, wolves, lynx and eagles. Dr. Nelson's assistants, Dr. Seymour Hadwin and Mr. L. J. Palmer, are already on the ground, and find a large field for discovery and experiment. Their report will surely be interesting.

The reindeer is used for food, clothing and transportation. It has been said of the animal that "it is valuable to the last hair." It is rare sport to drive the animal. In racing, a span of reindeer has made ten miles in twenty-seven to twenty-eight minutes.

CLOTHING FOR THE NATIVES

Reindeer were first introduced into Alaska to assist the natives to become self-supporting, and the animals now furnish the people of the far north with food, clothing and transportation. Trained veterinarians and animal husbandmen are needed to study and advise methods of control of reindeer diseases and to teach the Eskimos how to maintain their herds and improve the quality of the stock. Photograph by Lomen Bros. (Fig. 9.)

ON THE TRAIL, PILGRIM RIVER, ALASKA

The grading up of the reindeer into larger animals producing more meat can be readily brought about by crossing them with the native caribou from the interior of Alaska. Plans for scientific breeding have already been begun by the U. S. Department of Agriculture. The progress and usefulness of the reindeer in Alaska have greatly impressed the Canadians, and their government has undertaken a study of the industry with a view to its development in its own extensive grazing areas. Photograph by Lomen Bros. (Fig. 10.)

EXPORTATION OF REINDEER MEAT AND SKINS

The reindeer industry in Alaska has already reached a stage where it more than supplies the local demand, and exportation of meat and skins is being conducted by the firm of Lomen & Company.

The principal difficulties encountered by this company have been the necessity of making long, expensive and hazardous drives, in order to bring the animals to shipping points, equipped with cold storage plants (Nome, Keewalik and St. Michaels), and shipping the carcasses thence to market. Refrigerator boats have also been few and far between.

To relieve this situation this company is now building two additional cold storage plants, one at Golovin and one at Egavik, and plans are made to build at other stations in the near future. Under the present conditions the season's shipments will not exceed two thousand carcasses, averaging one hundred and fifty pounds each. Each year will see this quantity largely increased, depending quite as much upon the improvement in shipping facilities as on an increase in the growth of the herds.

A reduction statistically of the live stock of Sweden into "cattle units" gives the following result: one head of horned cattle is estimated as equal to two-thirds horse, = ten sheep, = twelve goats, = four pigs, = five reindeer. These units are interesting for purposes of comparison.

The reindeer industry will go far to solve the meat problem of the country, to reclaim the waste places of the territory, and help to conserve to the hunter and the epicure the wild game animals. All of which is of the greatest importance, considering that reindeer meat, or venison, is equal to, if not superior to all other venison, and a splendid substitute for beef and mutton.

THE HERALD[1]—NEW TYPE OF PRUNE

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THE commercial prune which is now grown so abundantly in the Pacific Northwest finds its origin in a group of European plums collectively known as *Prunus domestica*. No other species or group of plums, so far as the writer is aware, has ever before produced fruit that might properly be termed a prune. A variety, however, has recently been discovered which seems to disclaim all specific relationship with any of the European species. It presumably originated from one of the native American species, probably from that of *Prunus munsoniana* (Wight and Hedrick) and, notwithstanding this fact, it dries, cures and keeps indefinitely. Fresh specimens of fruit of this Herald prune, gathered on July 7, 1916, were laid away in the laboratory in cloth bags, and later, when air-dried, they were placed in a bottle with a tight-fitting cork stopper. Here they are today, after a period of three and one-half years, in as good condition as when first stored. The aroma from this fruit is pleasant and not unlike that of the common commercial product.

The original tree of the Herald variety was discovered in 1916 growing in the garden of Mr. W. F. Marshall of Raleigh, N. C., under the name of Milton plum. That is the name under which the owner had purchased the tree five or six years earlier from the Stark Bros. Nursery, Louisiana, Miss. The tree apparently belongs to the *Prunus munsoniana* species, of which the Milton is said to be a variety. It was critically studied for signs of hybridity with *Prunus domestica*, but no such traces, outside of the prune character, were observed. The variety seems to have originated from the native American species without any trace of foreign blood; and this is the most interesting feature of its account.

GENERAL DESCRIPTION OF THE VARIETY

In habit of growth the tree is spreading and has all of the bark, leaf, bud and flower characteristics pertaining to the Wild Goose group of plums. The fruit taken from the original tree measures from 30 to 35 mm. in length and 28 mm. in width. In general, it might be said to be oblong in shape and bright red in color, with a light coat of blue bloom. The dots are large, white and very numerous. The flesh is yellow, soft, juicy, sweet, and clings tenaciously to the pit. The stem, unlike that of other native species, clings to both branch and fruit, which fact prevents the latter from dropping to the ground as soon as ripe. The fruits on the tree are not crowded but hang free in the sunshine and wind, where they shrivel and dry naturally, after which they can be easily gathered and thoroughly cured indoors.

The pits from the original tree measure about 20 mm. in length, 12 to 14 mm. in width and 8 to 9 mm. in thickness. The surface is smooth and their shape is that of typical prune pits, that is, with one of the edges depressed and the other more rounded. All of the above measurements and descriptions are of the original tree and fruits. A remarkable difference was noted in the fruit taken from scions top-grafted to another species of plum, *Prunus angustifolia*.

COMPARISON OF HERALD PRUNE WITH MILTON PLUM

In the spring of 1917, scions from the original Herald prune tree were procured, and top-grafted 6 feet high to a *Prunus angustifolia* tree. Scions of the Milton variety of plum were also secured during the same year from the

[1] This new variety I have named the "Herald" because, although utterly worthless in itself as a prune, it may be the forerunner heralding a new strain for eastern America.

BRANCH OF HERALD PRUNE TREE IN FULL BLOOM

The original tree of this variety was discovered in a garden in Raleigh, North Carolina, growing under the name of Milton plum—the name by which the owner had purchased it in Louisiana six years before. Study of its prune characteristics gives evidence that it originated from native American species. (Photograph reduced.) (Fig. 11.)

FRUITS OF THE HERALD PRUNE

Nos. 1 and 3 are side views of Herald prunes three and one-half years old. No. 2 shows one of the prunes cut lengthwise to compare the size of the pit with the amount of flesh. Nos. 4 and 7 show the halves of the prune when cut transversely. Nos. 5 and 6 are two typical pits of the Herald variety. No. 8 shows the pit of a Herald prune when top-grafted to *Prunus angustifolia* stock, and Nos. 9 and 10 are typical pits from the *Prunus angustifolia* stock, natural size. Note the intermediate size between Nos. 5 and 6 and 9 and 10. (Fig. 12.)

BRANCH OF THE HERALD PRUNE WITH TWO DRIED FRUITS

This branch was taken from the original tree. The fruits do not readily drop to the ground when ripe, but cling to the branches where they are not crowded, and they dry naturally in the sun. Photograph reduced. (Fig. 13.)

Indiana Agricultural Experiment Station, through the courtesy of Prof. H. J. Reed, and top-worked for the sake of comparison to the identical *Prunus angustifolia* tree. Every graft of both varieties grew and later produced fruit. It was soon noticed that the Herald prune is a less vigorous grower, and this is verified by numerous trees on similar stock root-grafted during the same season. The leaves are somewhat smaller both in length and width, the bark is more brown, even on the under or shady side of the branch, and the fruit buds develop more abundantly on the new wood. The flowers on Herald scions, which were forced in water in the greenhouse, as well as those that were produced in 1918 and 1919 on the top-worked tree, show quite a distinct difference from those of the Milton variety that were similarly forced and grown. The limb of the corolla of the Milton flower measures on the average about 13 mm. while that of the Herald flower measures 17 mm. The individual petals of the latter also show correspondingly increased measurements.

A heavy frost occurring on March 10, 1918, destroyed most of the flowers of both varieties and, of those that escaped, many were destroyed by curculio injury. However, one normal prune and six normal plums were secured, and from these the following comparisons were made. Five of the Milton variety were ripe and had dropped on June 16, with their stems remaining attached to the tree, while the last of sixth fruit ripened and dropped as late as June 29. The Herald variety ripened its fruit with the fruit of the Milton plums, but clung to the tree and had begun to shrivel when the last of the Milton variety dropped, and then it actually had to be detached. The plums soon deteriorated in the laboratory while the prune shriveled and cured easily. The fruits of both varieties are practically the same in color and consistency. The plums are slightly longer than they are broad, while the prunes are more oblong in shape. The dots on the plum are decidedly more numerous on the upper half, while on the prune they are distributed quite uniformly all over the fruit. Both varieties are of the clingstone type, but the pit of the prune is larger in all dimensions than that of the plum. The Herald prune scions seem to make an uncongenial union with *Prunus angustifolia*, for the entire lot of those that were top-worked—six

FRUITS FROM THE ORIGINAL HERALD PRUNE TREE

The fruit at the left is ripe and turgid like a plum in its prime. The one at the right is dry and shrivelled like a prune. The two central fruits show conditions at different stages of drying. Photograph natural size. (Fig. 14.)

BRANCH FROM ORIGINAL HERALD PRUNE TREE

The fruits are scattered over the tree and hang free to dry naturally in the sunshine and wind. Note that the outermost fruit at the right is turgid and ripe while the two fruits to the left of it are beyond the plum stage and have begun to shrivel. (Fig. 15.)

in all—had but a brief existence and died while blooming in the spring of 1919. They died for no other apparent reason than that of uncongeniality of stock, while all of the Milton plum scions, also six in number, seems as vigorous today as ever. Even this brief comparison would readily indicate the two samples of fruit are of distinctly different varieties.

THE EFFECT OF STOCK ON SCION

It will be of general interest to note at this time what effect a different stock, *e. g.*, *Prunus angustifolia*, exerts on the Herald variety of prune, and undoubtedly a similar effect might be observed on other varieties of plums and prunes when so united. The fruit from the top-worked tree measures 5 mm. less in length and 4 mm. less in width than that from the original tree. The pit also lacks 3 mm. in length, 1 mm. in width and a fraction of a millimeter in thickness. Its surface is velvety, like that of the pits of the *Prunus angustifolia* species, while the surface of the pits from fruits taken from the original tree is hard and less velvety. Again, the characteristic prune-shaped pit is much less pronounced; in fact, it greatly resembles those of the *Prunus angustifolia* species.

As the original Herald prune tree was purchased for the Milton variety of plum from a reliable nursery, and as no such prune variety had knowingly been propagated by that nursery, one is led to believe that a mutation arising from the native *Prunus monsoniana* species has occurred. The tree is supposed to be budded stock, but whether this is true or whether the bud died in the nursery and a root mutation has actually occurred—in other words, whether the tree is growing on its own roots or on those of another variety—cannot be determined at this time. The most interesting feature of this variety seems to be that a true prune, one that will dry on the tree and cure perfectly without removing the pit, although of no commercial value as a prune, has developed from one of our native American species of plums.

Great as our interest may be in such a discovery, it must be remembered, of course, that this particular variety, because of its soft texture and juicy flesh, cannot be expected to compete with any of those of the commercial prune, *i. e.*, of the *Prunus domestica* species. Not until a great amount of work has been done in hybridizing this new Herald prune with the better commercial sorts can we hope to be rewarded by virtue of such a discovery. In the south, where the *Prunus domestica* species cannot easily be grown because of climatic conditions and fungus diseases, this late blooming and apparently highly resistant native prune might be utilized in hybridization work to make possible the growing of a new strain of prune for eastern America.

A Contribution to Eugenics

PERSONAL BEAUTY AND RACIAL BETTERMENT, by Knight Dunlap, professor of experimental psychology in the Johns Hopkins Hospital, Baltimore. Pp. 95, price $1. St. Louis, C. V. Mosby Co., 1920.

True personal beauty is the best single guide to sound sexual selection, according to Professor Dunlap; and he develops this point with plausible ingenuity, although without any statistical basis. The second part of the book is an essay on applied eugenics. Dr. Dunlap does not favor sterilization, does favor segregation, and believes much could be accomplished by proper propaganda of birth-control.

The book is filled with interesting and penetrating ideas, with most of which eugenists will agree. It is written simply and readably, and is worth reading. It deserves to be very widely circulated.—P. P.

RACE ASSIMILATION BY THE PURE-SIRE METHOD

Harry H. Laughlin, Sc.D.
Assistant Director, Eugenics Record Office

WHILE it has been demonstrated to the satisfaction of students of pedigrees that in most species the ancestral contributions of the dam and the sire are about equal, still on account of physiological and social considerations the pure-sire method is much more potent than a possible pure-dam method would be in race improvement. The principal reason is that physiologically the reproductive capacities of the race are limited, not by the number of fertile sires, but by the number of fertile dams. But in the human race almost equally potent is this social or mate-selection factor whereby the women of the lower races usually show a preference for men of higher racial levels. Furthermore the *mores* of most states cast less social obloquy upon the fathers than upon the mothers of an illegitimate child, and similarly less reproach is directed toward a legitimate mating between a man belonging to a "high" race and a woman of "inferior" blood than toward the reverse type of marriage.

RACE-MIXTURE IN EARLY SPANISH-AMERICA

In historic times we have interesting examples of race improvement or assimilation by a process which is quite analogous to the pure-sire method with which we are familiar in the animal kingdom. In the early days of Spanish America, there were many more men than women who came from the mother country and settled in the new world. The result was that there began almost immediately a process of race-mixture which was quite lacking in the regions settled by the northern European colonists. In the latter case the immigration to the new world consisted largely of colonists and their families who came into a comparatively unsettled country in search of new homes, whereas in the case of Spain, the conquistadors—armies of men alone—came seeking wealth, adventure and colonial possessions.

From the social side, we find in the new world this situation: the average Spaniard, or man with considerable Spanish blood, would of necessity, on account of the scarcity of Spanish women, have to remain a bachelor or marry a wife with less Spanish blood on the average, than he himself carried. The result was, from the standpoint of the Spaniard, that his offspring were of less pure Spanish descent, while from the standpoint of the native Indian or imported negro, the offspring were of a decidedly higher racial level.

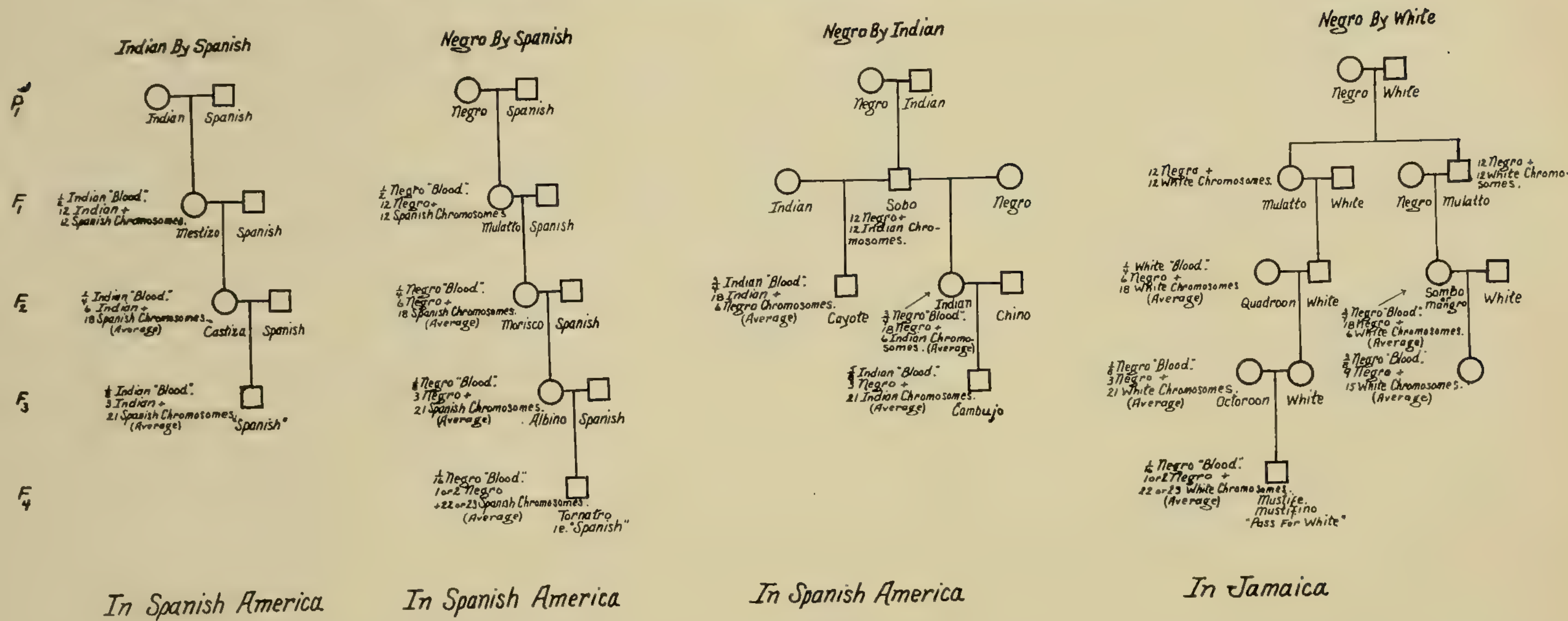
EFFICACY OF THE PURE-SIRE METHOD

It appears that a man with "a touch" of Indian or negro blood could return to Spain with his Spanish father and enter Spanish society much more readily than could a daughter with Indian or colored blood. The process of race assimilation by the pure-sire method became so common in Latin America that there developed a definite system of nomenclature[1] for describing the products of each particular generation of offspring. The accompanying pedigree-chart shows this process in detail, and attention is called to the sureness with which race assimilation is achieved by clinging to the pure-sire method, whereas in case this system is dropped, confusion results and a mixed race is the product.

The efficacy of the pure-sire method is doubly assured when we remember that in man, as in other animals, the germ-plasm is not indefinitely dilutable, but segregates into chromosomes which in their entirety (barring crossing-over) either do or do not pass from a given ancestor to the offspring. We shall not go into this matter here,

[1] J. Deniker, The Races of Man, 1913, p. 542.

The Pure Sire Method Of Race Assimilation in America.



A pedigree chart illustrating the process of race assimilation by the pure-sire method. "In the early days of Spanish-America, there were many more men than women who came from the mother country and settled in the new world. The result was that there began almost immediately a process of race mixture which was quite lacking in the regions settled by the north European colonists." It was necessary for the man of Spanish blood to "remain a bachelor or marry a wife with less Spanish blood on the average than he himself carried." The diagram above indicates the system of nomenclature which became necessary to describe the offspring of each generation. (Fig. 16.)

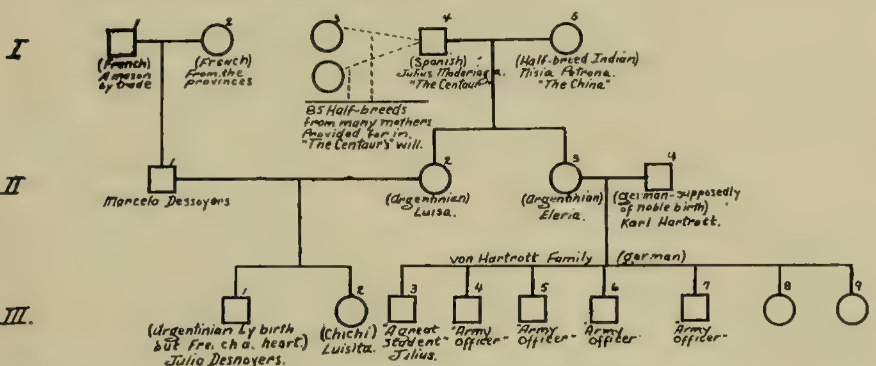


Fig. 17

Pedigree Chart from "Four Horsemen of the Apocalypse," by Vincente Blasco Ibañez.

but we know that on the average one out of every 4,096 human beings that we see has entirely eliminated the ancestral chromosomes of his or her mother's mother, and one out of 2,048 his or her father's mother.[2] In such cases there is not even a "touch" of that particular grandparent's "blood" remaining. It requires just as many generations of pure-sire assimilation to eliminate the "blood" of an ancestor of one race as of another; for example, it would take just as long for a mixed "pass-for-English" family to "breed-out" its French or its German ancestry as it would to rid itself of its negro or Chinese "blood." But practically, because of the many basic qualities common to closely related races, the apparent racial assimilation is, in such cases, often completed in one or two generations. In these cases some foreign "blood" persists, but it is "not so very foreign," so that if supported by social assimilation, the transfusion, for all practical purposes, is quite complete.

A NOVELIST'S ILLUSTRATION

Vicente Blasco Ibañez claims (and his claim is generally credited) that in his novels he portrays social and scientific facts in a much more reliable manner than the ordinary imaginative novelist uses. In "The Four Horsemen of the Apocalypse"[3] he gives the story of a Spanish-American family which, by the pure-sire method, "bred up" the descendants of a half-breed Indian woman ("The China"), first to Argentinians; then through one daughter, by marriage with a Frenchman, we find in one more generation children "passing-for-French," and through the second daughter, who married a German, von Hartrott, the children "pass-for-German." The pedigree-chart diagramming this family is given in this article not because it is a pedigree of an actual family, but because it is a type-pedigree on which history, sociology and anthropology place the stamp of accuracy. A writer with wild rather than a constructive imagination, and with less knowledge of history for a background, would not have built his story on a pedigree so typical of the true situation.

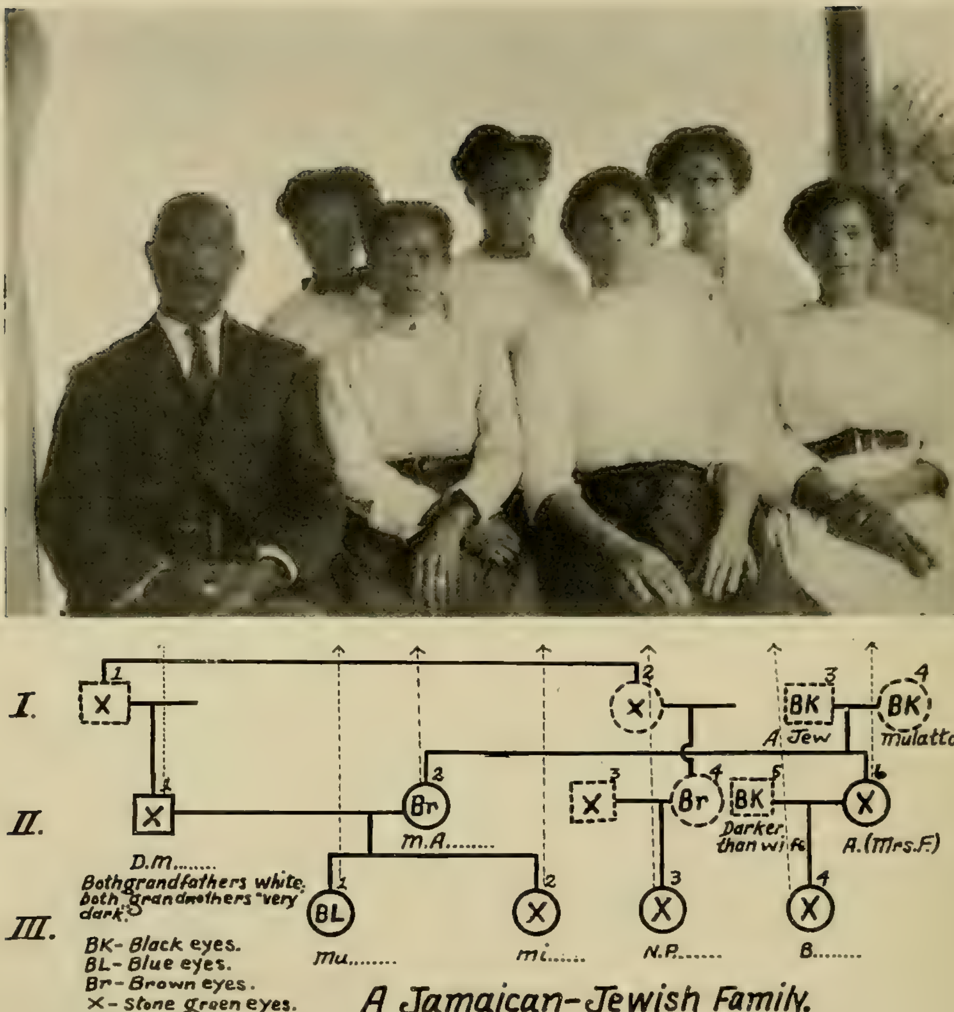
JEWS MIX WITH OTHER RACES

But whenever two races come into close contact for a long period of years, race-mixture is certain to result. Even the Jews,[4] who claim to have preserved a certain racial purity from ancient times, are found to mix with the people of each territory which they occupy.

[2] Harry H. Laughlin, Calculating Ancestral Influence in Man: A Mathematical Measure of the Demonstrated Facts of Bi-Sexual Heredity. In press in "Genetics."

[3] Vicente Blasco Ibañez, The Four Horsemen of the Apocalypse (Fiction). American translation 1918.

[4] Redcliffe N. Salaman, M. D., Heredity in the Jew. The Eugenics Review, pp. 187–200, Vol. III, 1911–12.



"In the family-tree here plotted, there are two persons of half-Jewish blood, three of one-quarter Jewish blood, and two with no Jewish blood at all." (Fig. 18.)

Thus we speak of German-Jews, or even of Chinese-Jews.[5] In each case the so-called Jew presents a mixture of those traits which we think of as typically Jewish with those of the race among which the particular Jewish strain is living. Thus we must think of the Jews as an institution and a society as well as a race. Their racial traits may constitute the principal background of Judaism, but that is not the whole story.

In the accompanying picture of a Jamaican family is found a case of Negro-Jews. In the family-tree here plotted, there are two persons of half-Jewish blood, three of one-quarter Jewish blood, and two with no Jewish blood at all. The observer can, if he be keen, locate in the picture those with and those without Jewish blood. This particular family, due doubtless to the infusion of Jewish traits, was much more successful socially and economically than the average Jamaican family with an equivalent proportion of other but less socially competent white blood.

[5] Maurice Fishberg, The Jews, 1911, p. 134.

ONE TYPE OF RACE MIXTURE IN JAMAICA, B. W. I.

(School Children in the Town of Moneague.) See the text below for explanation. (Fig. 19.)

BLENDING OF RACIAL TRAITS

Another picture here shown is of three children from a school in a Jamaican town. The boy to the left is a Hindu[6] coolie with no negro blood in his veins, although his skin is as black as that of the average quarter-blood negro. His features, however, do not disclose any negroid traits. The boy to the right is a "Sambo,"[7] that is of three-quarters black and one-quarter white blood. The little girl in the centre is descended from a Hindu coolie father and a "Sambo" mother. Here we see racial traits blending. This blend is especially noticeable in the hair, the nose and the lips. So potent is the pure-sire[8] method of race assimilation that should this girl, her daughters and her granddaughters marry Hindu co lies, doubtless the racial transformation would be complete in that direction; or if, on the other hand, she and her daughters and granddaughters were to marry "Jamaicans," the assimilation of her descendants by the latter race would be equally complete.

CONCLUSION

The data given in this article are isolated but th y are representative facts from the mass of anthropological evidence which demonstrates the general fact that whenever two races come into intimate contact the upper race tends to remain pure while the lower tends toward assimilation into the upper, by the pure-sire system. Thus the expression "the salvation of a great nation is the virtue of its women" is true racially as well as socially and morally. So long as the basic instincts and the social ideals of mankind remain as they are today, and have been since man first appeared, racial evolution and assimilation will tend toward the race-types of men which the women of the particular nation choose as mates.

[6] On March 31, 1918 there were 20,206 East Indian immigrants in Jamaica. They are brought in principally to work on the sugar plantations.

[7] Chas. B. Davenport, Heredity of Skin Color in Negro-White Crosses, 1913, p. 27.

[8] Harry H. Laughlin, The Relation between the Number of Chromosomes of a Species and the Rate of Elimination of Mongrel Blood by the Pure-Sire Method. Proceedings of the Society for Experimental Biology and Medicine, 1919, xvi., pp. 132–134.

TYPICAL WILD FORM OF THE TREE DAHLIA

It is in this form—a tall plant producing lilac-pink single flowers—that *Dahlia maxoni* occurs in the highlands of Guatemala. When brought into cultivation it gives rise to double-flowered varieties of several shades of color. The stem here shown was cut and photographed by the roadside on the slopes of the Volcan de Agua, near Antigua, Guatemala. (Fig. 20.)

THE TREE DAHLIA OF GUATEMALA

WILSON POPENOE
Agricultural Explorer, United States Department of Agriculture

RIDING through the Guatemalan highlands in the months of December or January, the traveler is certain to be impressed with the beauty of the wild tree dahlia whose starry, lilac-pink flowers, in graceful clusters upon long slender stems, break the somber monotony of a dark green hillside in a most effective manner. And as he enters one of the picturesque Indian villages of the highlands, particularly if he be so fortunate as to find himself in the town of Tactic, he is sure to be enchanted by the flowering hedges of this plant which surround the diminutive gardens of the people.

SUITABLE FOR SUB-TROPICAL AREAS

Why has not the Guatemalan tree dahlia become more widely known horticulturally? A plant at once so beautiful, so conspicuous in its native home, and so readily propagated should be one of the first to be carried to other lands; yet *Dahlia maxoni* (such is the n me under which the species is now known) seems never to have become widely distributed. Probably this is due to the fact that its climatic requirements fit it for cultivation only in the mildest parts of the sub-tropics, or in the tropics at elevations sufficiently high to temper the heat. When planted in northern gardens, it is cut down by frost before it has had an opportunity to come into flower, though in favored situations in southern California it has occasionally bloomed gorgeously. In Florida, if the proper soil conditions can be provided, it should prove successful. And certainly there are many places in northern India, in southern Japan, in sub-tropical Brazil, and numerous other countries where it would find congenial surroundings, and where it would prove an excellent addition to the list of garden plants.

To the Kekchi Indians of northern Guatemala, this dahlia is known as *tzolokh*, while those who speak the Pokonchi language call it *shikor*. Spanish-speaking Guatemalans usually term it *Santa Catarina*. Though extremely abundant, both wild and cultivated, in many parts of the Guatemalan highlands (principally between 3,000 and 7,000 feet elevation) it seems never to have received much attention from botanists; indeed, W. E. Safford, of the U. S. Department of Agriculture, last year found that it had not yet received even a name, hence he described it as *Dahlia maxoni*, in honor of William A. Maxon, of the U. S. National Herbarium.

FOUR DISTINCT FORMS

When I first saw this plant in Guatemala during the winter of 1916-17, I felt immediately that it was worthy of horticultural attention. Still more was I impressed with its possibilities when I found what appeared to be four distinct forms of the species; the type, which is single-flowered and lilac-pink in color; a single-flowered white variety, identical with the type except in color; and two double-flowered varieties—one lilac-pink and one white. I sent cuttings of these double-flowered forms to Washington, where they were propagated but later lost by freezing, and I took home with me photographs of them. From my description of the plant, and from photographs, Mr. Safford thought the double-flowered form so distinct from the type that he did not include it in his description of *Dahlia maxoni*.

Upon returning to Guatemala, and again seeing the tree dahlia in bloom, I have been able to satisfy myself that the double-flowered varieties have their origin in the single-flowered, typical form, and properly belong to the same species.

As a wild plant, upon the mountainsides removed from cultivation, I have never seen any other than the typical form, with eight lilac-pink ray-florets

THE TREE DAHLIA IN CULTIVATION

The double-flowered forms which originate in cultivation are propagated by cuttings and planted in gardens or hedgerows. The huge size to which the plants may grow is shown by this row along a fence in Tactic, Guatemaia. This variety is lilac-pink in color. (Fig. 21.)

THREE FLOWERS FROM A SINGLE PLANT

The origin of double-flowered varieties by bud-sporting or mutation is illustrated by the three flowers shown in this illustration. All of them were taken from the same plant, growing in a hedgerow at Tactic, Guatemala. The flower on the left is single, practically the same as those produced by wild plants; the one in the center is an intermediate, while on the right is one which has become fully double. (Fig. 22.)

and a compact group of small yellow disk-florets. Sometimes the stems reach 15 or even 18 feet in height, and become quite woody toward the base. They terminate in a number of slender branches, each bearing several flowers, not all of which open at one time. The flowers face outwards and upwards, one of the characteristics which distinguishes this species from *D. imperialis*. The flowers of the latter are distinctly nodding.

When brought into cultivation around the huts of the Indians the species seems to lose its stability. In place of single lilac-pink flowers other forms often appear, and since the plant is readily propagated by cuttings it is a simple matter to reproduce these variations. The single white variety is relatively rare, and its flowers are much in demand among the Indians for decorating the images of saints which all of them keep in their homes. The double white is somewhat more abundant, and the double lilac-pink is perhaps the commonest of all the variations from the type. I have seen all of these forms both in northern Guatemala (Tactic and Coban) and in the central part of the country, near Antigua.

WIDE RANGE OF FORM AND COLOR

It is evident that the double-flowered forms originate as bud-sports from the single ones, for I have found numerous plants, both in northern Guatemala and near Antigua, on which there were flowers of both types, as well as intermediate forms. Figure 22 shows three flowers from a single plant growing in a hedgerow at Tactic, Alta Verapaz. On the left is the typical flower with eight ray-florets, and numerous minute yellow disk-florets closely crowded together. In the center flower many of the disk-florets are no longer small and yellow, but have become more like the ray-florets in character and similar in color—lilac-pink in this instance. In the flower on the right, the disk-florets are still larger, and the flower has become quite double. Even in the double-flowered form, however, the ray-florets can be distinguished from the altered disk-florets. In the flower shown in the photograph, the ray-florets appear in the rear, larger and broader than the rest. While the typical, single-flowered form produces fertile seed in abundance, I have been unable to find any seed produced by the double-flowered varieties.

The largest flowers, whether single or double, measure four or five inches in diameter. In the double-flowered forms there are various shades of color. I have seen a bright lilac-pink—almost a pure pink; a deep lilac-pink; and a darker shade which could almost be called a mauve.

The wide range of form and color which horticulturists have obtained from the several species of Dahlia cultivated in the north is familiar to everyone. Varieties have been produced both by crossing, and through the vegetative propagation of forms which originated as bud-sports. The only defect of *Dahlia maxoni*, from the northern horticulturist's point of view, is the long growing season which it requires in order to reach the flowering stage. But will it not be possible, by crossing this species with some of those now cultivated in the north, to produce interesting and valuable forms which will be successful under practically the same conditions as the cactus and other groups of cultivated dahlias? Certainly a species which grows to eighteen feet in height, and which exhibits a strong tendency to produce handsome double-flowered sports, will not be without interest to American dahlia breeders!

CHLOROPHYLL FACTORS OF MAIZE

Their Distribution on the Chromosomes and Relation to the Problem of Inbreeding.[1]

E. W. LINDSTROM
Department of Genetics, University of Wisconsin

IT IS a significant fact that the great majority of heritable characters known in maize are recessive to the normal type in inheritance. Such characters as *dwarfness*, *ramosa* ear, *liguleless* leaf, chlorophyll characters such as *white*, *virescent-white*, and *yellow* seedlings, *golden*, *green-striped*, *Japonica*, *fine-striped*, and the *lineate-leaved* plants are all simple Mendelian recessives to the common or normal type of maize. Disregarding aleurone, pericarp and endosperm characters, since one is not certain as to what is normal in those respects, only one character, pod-corn, has been definitely shown to be dominant. Strangely enough this dominant character, pod-corn, is almost completely sterile in the homozygous dominant condition.

Most of these recessive characters influence the life and vigor of the maize plant directly. The presence of one of them often seriously affects the life and productivity of the plant. If any such abnormalities were dominant characters they would quickly perish in the struggle for existence without leaving a trace. Because they are recessive in inheritance they can be carried along from one generation to the next in normal appearing plants, heterozygous for the abnormal factors. This is obviously the reason for the presence of so many recessive characters and so few dominant ones in maize.

INFLUENCE OF RECESSIVE CHARACTERS

The relation between such recessive characters and the question of inbreeding is very intimate. Continued inbreeding of maize is nearly always followed by a decrease in stature, yield and fertility. This, together with the facts that the maize plant is normally in a heterozygous condition because of its method of open-pollination and that recessive abnormalities are abundant, at once suggests that the artificial inbreeding of maize merely isolates the recessive characters which are relatively poor in stature, yield or fertility.

Having once eliminated these poor characters by selective inbreeding, one might suppose that the remaining plants, being relatively free from such abnormalities, would now possess only the better characters. This, however, is true only to a very limited extent. The actual results of maize inbreeding have not been successful in producing such superior stock.

Apparently the reason for this is the influence of linkage on the distribution of characters. If one could eliminate most of the inferior characters without disturbing the favorable complex, the problem would be solved. But it seems that when we isolate and eliminate the poorer types by inbreeding, at the same time we discard some of the better factors that are correlated with the unfavorable ones in inheritance. Such a situation is expected from our present knowledge of the linkage relations of an organism.

It seems safe to assume that such favorable factors as influence size, yield, good quality, and fertility are multiple in nature and undoubtedly are distributed in all the ten pairs of chromosomes in maize. Certainly the facts of size inheritance appear to confirm this.

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[1] Papers from the Department of Genetics, Agricultural Experiment Station, University of Wisconsin, No. 22. Published with the approval of the Director of the Station.
Some of the original crosses reported in this article were made at the New York State College of Agriculture at Cornell University, Department of Plant Breeding.

MAIZE SEEDLINGS

Showing segregation into tall green, tall virescent-white, dwarf green and dwarf virescent-white. In this particular row, these four types occur in the proportion of 16:5:6:4 respectively. "Dwarfness in maize is a simple Mendelian recessive to the tall normal type. The virescent-white character is also a simple recessive to normal green." (Fig. 23.)

EFFECT OF UNFAVORABLE FACTORS

But what of the distribution of the unfavorable factors in the chromosomes? If we can demonstrate that many factors causing a reduction in the vigor of the maize plant are distributed in many different chromosomes, it would add positive evidence to the present theory on the effects of inbreeding. It is the purpose of this paper to point out the distribution of some such unfavorable factors, especially those concerned with the development of chlorophyll.

Chlorophyll abnormalities are very prevalent in all types of corn. They have been observed in dent, flint, sweet, pop and flour corn. These abnormalities vary from a total absence of all pigment (shown in pure white or albino seedlings) to shades of light green that are almost indistinguishable from normal green. An intensive search for such chlorophyll defects surprises one by their frequent occurrence. The presence of any one of these recessive chlorophyll abnormalities in a commercial strain of corn is a serious factor in reducing yield.

At least eight factors that influence the inheritance of chlorophyll have already been reported. These are the seedling factors producing *white*, *virescent-white*, and *yellow* seedlings and the mature plant factors producing *golden*, *green-striped*, *Japonica* (both green-white and green-yellow striped), *fine-striped* and *lineate* plants. In addition there are three new factors, still under investigation, making a total of eleven factors governing the formation and expression of chlorophyll in maize.

It must not be supposed that these eleven factors comprise most of the actual number concerned in chlorophyll inheritance. They only represent the ones that are most easily handled. There are certainly many others, especially those which produce the lighter shades of green so often observed in different types of maize. But these are very difficult to work with, since their expression is greatly modified by external conditions. Such factors also would influence the vigor and yield of the plant. It is to be confidently expected that their inheritance will prove to be similar to that of the eleven factors already known.

In a previous publication[2] it has been shown that many of the chlorophyll factors are inherited independently of each other. It has also been shown that two of them (*l*, *yellow* seedlings and *g*, *golden* plants) are linked in inheritance.

Further evidence is now presented to show that some of these same chlorophyll factors are inherited independently of still other factors.

RELATION OF WHITE (ALBINO) SEEDLINGS TO ALEURONE AND ENDOSPERM FACTORS

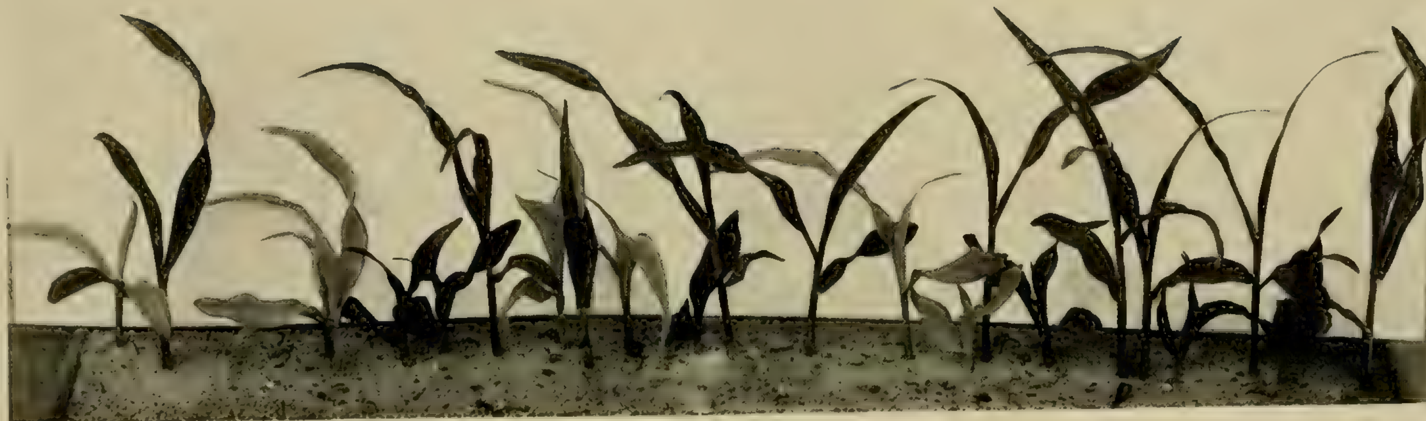
A sweet corn with colored aleurone, of the composition $iiAACCP_rP_rRR\ s_u\ s_u\ WW$, was pollinated by a plant with starchy, colorless endosperm, heterozygous for albino seedlings ($iiAACC\ P_rP_r\ rr\ S_u\ S_u\ Ww$). The F_1 endosperm was starchy and had purple aleurone color in all of the grains The F_1 plants were all normal green.

Ten F_1 plants were self-pollinated. The F_2 grains on all showed a distinct 9:3:3:1 ratio of purple starchy, purple sugary, colorless starchy and colorless sugary grains, respectively. These four types of seed from each ear were planted separately. Among the ten F_2 seedling progenies, six produced nothing but green seedlings, while four showed a sharp segregation into green and white seedlings. The expectation in this respect was of course five and five.

The four F_2 progenies that showed segr gation are presented in Table I.

It will be noted that three of the four seedling progenies are grouped together while the fourth (2959) has been segregated and totalled separately. This was done because 2959 was a poorly developed ear that showed

[2] Lindstrom, E. W. Chlorophyll inheritance in maize. Cornell Univ. Agr. Exp. Sta. Memoir 13:1–68. 1918.



MAIZE SEEDLINGS

Showing segregation into tall green, tall yellow, dwarf green and dwarf yellow. In this particular row the proportion of these four types is 10:6:6:1 respectively. "A tall green plant which produced 75% green and 25% yellow seedlings when self-pollinated, was crossed by a dwarf plant. . . The F_1 plants of this cross were all tall and normal green. Three of them were self-pollinated and their seedling progenies tested in the greenhouse. All three showed approximately 25% dwarf seedlings, which are easily distinguished in this photograph. (Fig. 24.)

indications of pollen contamination. It is included in the table only to present all the data in this experiment.

The relations between the various factors involved in this cross can be studied best by taking two pairs of factors at a time. The interrelation between the *Ww* factor pair, governing chlorophyll inheritance and the *Su su* pair, determining starchy and sugary endosperm, will be considered first. Using the data from the three ears (2955, 2956, 2969) that show no evidence of pollen contamination, the following results are obtained when the starchy seeds (indicated by *Su*) are considered separately from the sugary (*su*) seeds:—

	Su W	*Su w*	*su W*	*su w*
Observed	507	161	155	46
Calculated	489	163	163	54

The actual or observed results approximate a 9:3:3:1 ratio very closely. The starchy seeds show a proportion of 3 green seedlings to 1 white as do the sugary seeds. In fact, the closeness of fit, as measured by *P* is .53, which indicates that there is good agreement between the facts and the hypothesis of independent Mendelian inheritance between the chlorophyll and endosperm factors.

The numbers are sufficiently large and the approximation to the theoretical expectancy is so close that we can be reasonably certain that *w* and *su* are not linked in inheritance. In other words, the albino chlorophyll factor is not on the same chromosome as the sugary endosperm factor.

ALEURONE AND CHLOROPHYLL FACTORS

If the relation between aleurone color and chlorophyll development is considered next, similar results obtain. In this case the purple aleurone grains (indicated by *R*) are classified separately from the colorless grains (*r*). The green and white seedlings resulting from these two types of seed are as follows:

	R W	*R w*	*r W*	*r w*
Observed	482	155	180	52
Calculated	489	163	163	54

Both purple and colorless seeds give approximately 75% green and 25% white seedlings, resulting in a 9:3:3:1 ratio. The calculated value for *P* is .51 which means good agreement between actual and theoretical results.

From such data we can draw the conclusion that *w* and *r* are not linked, but that the chlorophyll factor *w* is located in a different chromosome than is the aleurone factor *r*.

From the data in Table I, it can be shown that the *r* and *su* factors also are independently inherited. When grouped according to these factors the data are as follows:

	R Su	*R su*	*r Su*	*r su*
Observed	489	148	179	53
Calculated	489	163	163	54

The agreement between the actual and the theoretical results is not as good as in the preceding cases since the value

TABLE I: *F_2 Seedlings from Four Self-pollinated F_1 Plants of the Composition i i P_r P_r A A C C R_r S_u su Ww**

Pedigree No.	Purple Starchy Seed		Purple Sugary Seed		Colorless Starchy Seed		Colorless Sugary Seed	
	Green	White	Green	White	Green	White	Green	White
2955	148	58	56	12	56	16	18	7
2956	74	17	18	6	20	10	6	1
2969	144	48	42	14	65	12	15	6
Total	366	123	116	32	141	38	39	14
Theoretical	367	122	122	41	122	41	41	14
2959	87	18	25	5	48	2	8	0
Total	453	141	141	37	189	40	47	14
Theoretical	448	149	149	50	149	50	50	17

*Original cross made by Mr. E. G. Anderson of the Department of Plant Breeding, New York State College of Agriculture at Cornell University.

of P is .40. The odds are approximately 1.5 to 1 against the observed deviations being due to chance only. Such odds are, however, not considered as seriously vitiating the hypothesis of independent inheritance of *r* and *su*.

The preceding facts demonstrate that the chlorophyll abnormality of albino seedlings is not linked with either the sugary character nor the aleurone factor *r*. Factors *w*, *su* and *r* are each on separate chromosomes.

RELATION BETWEEN DWARFNESS AND VIRESCENT-WHITE SEEDLINGS

Dwarfness in maize is a simple Mendelian recessive to the tall normal type. The virescent-white character is also a simple recessive to normal green. Virescent-white seedlings contain very little chlorophyll at first, but under favorable conditions of light and temperature, they gradually assume a light green color. It has been possible to bring some of them to maturity.

TABLE II: *Seedling Progenies from Self-pollinated Normal Green Plants Heterozygous for Tall-dwarf and Green-Virescent-white*

Pedigree No.	Tall Green	Tall Virescent-white	Dwarf Green	Dwarf Virescent-white
2862	63	24	27	11
2871	52	21	20	6
2991	57	19	16	5
2992	52	22	20	7
3017	178	52	52	11
Total	402	138	135	40
Theoretical (9:3:3:1)	402	134	134	45

Several green plants heterozygous for the virescent-white factor (*Vv*) were pollinated by homozygous green, dwarf plants. The F_1 progeny was all tall and dark green. When self-pollinated the F_1 plants produced, as was to be expected, two sorts of seedling progenies. One sort consisted entirely of green seedlings, the other segregated into green and virescent-white. Both sorts segregated into tall and dwarf seedlings. The segregation into tall green, dwarf green, tall virescent-white and dwarf virescent-white which occurred in five of the progenies was distinct, as can readily be seen in Fig. 23.

Seedling counts were made of the five progenies that showed segregation into the four classes noted above. They are recorded in Table II.

The data in this table conform closely to a 9:3:3:1 ratio and accordingly indicates that dwarfness and virescent-white chlorophyll are inherited independently of each other. Hence, the chlorophyll factor *v* is not in the same chromosome as the dwarf factor concerned in this cross.

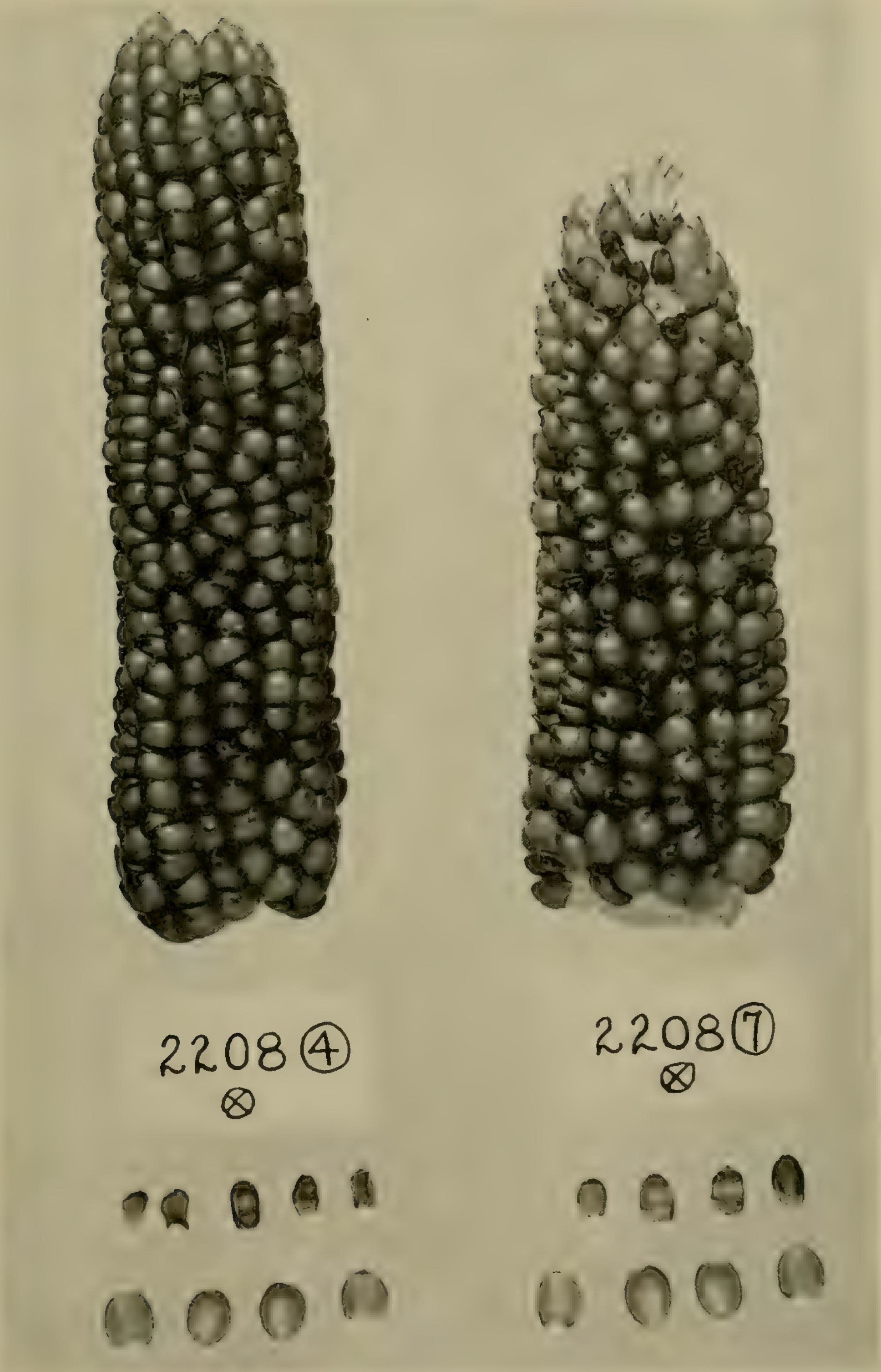
RELATION BETWEEN DWARFNESS AND XANTHOPHYLL PIGMENT

In addition to the white and virescent-white chlorophyll types, there is a third type which also is recessive to normal green. This recessive character is seen in maize seedlings that develop a distinct yellow color apparently due to the pigments xanthophyll and carotin.

A tall green plant, which produced 75% green and 25% yellow seedlings when self-pollinated, was crossed by a dwarf plant. This dwarf was of the semi-tall type with anthers in the ear. It is also a simple recessive to the tall type, but is caused by a different genetic factor than the dwarf type used in the virescent-white cross.

The F_1 plants of this cross were all tall and normal green. Three of them were self-pollinated and their seedling progenies tested in the greenhouse. All three showed approximately 25% dwarf seedlings, which are easily distinguished as can be seen from Fig. 24. Two of the progenies also segregated for the yellow seedling character, producing tall green, dwarf green, tall yellow and dwarf yellow in proportions indicated in Table III.

An analysis of this table shows that the actual results obtained do not agree very closely with the theoretical expectancy of a 9:3:3:1 ratio. The extreme classes (tall green and dwarf yellow) taken together are deficient while the middle classes (tall yellow and dwarf green) are slightly in excess



TWO SELF-POLLINATED EARS OF MAIZE

Showing approximately twenty-five percent of abortive grains. Below the labels are shown some individual abortive grains (upper rows) and some normal grains (lower rows) from these ears. (Fig. 25.)

TABLE III: *Seedling Progenies from Self-pollinated Normal Green Plants Heterozygous for Tall-dwarf and Green-Yellow Seedlings*

Pedigree No.	Tall Green	Tall Yellow	Dwarf Green	Dwarf Yellow
3006	180	72	87	22
3011	32	7	11	2
Total	212	79	98	24
Theoretical (9:3:3:1)	232	78	78	26
Calculated on 1:1.4 linkage	225	85	85	18

of the theoretical on the basis of independent assortment. If this is a case of linkage, such a situation would be expected, since the tall and yellow characters came from one parent, while the dwarf and green characters entered from the other parent of the cross.

If a linkage giving a gametic ratio of 1:1.4 is assumed, the calculated numbers agree more closely with the actual results. This indicates that the tall-yellow and dwarf-green gametes are produced approximately 1.4 times more often than the tall-green and dwarf-yellow gametes. The numbers are too small, however, for more than a suggestion of linkage. Further tests are being planned to determine this relation.

It happens that the chlorophyll factor involved in the dwarf-yellow cross is identical with the one in the dwarf-virescent-white cross discussed in the preceding section. In both cases it is the *v factor* (LLvv and llvv).

In the dwarf-virescent-white cross there was no indication of linkage between the chlorophyll factor *v* and the type of dwarf involved. In the dwarf-yellow cross however, there is a suggestion of a linkage between this same *v* and the semi-tall dwarf used there. This can only mean that the two sorts of dwarfs are genetically different and that their respective factors are located on different chromosomes.

INHERITANCE OF ABORTIVE GRAINS IN MAIZE

In connection with the study of chlorophyll factors there occurred, among several self-pollinated ears of a certain cross, a single ear that showed an appreciable number of abortive grains. At first this was thought to be the result of poor pollen or imperfect pollination. But the recurrence of the phenomenon for two years dispelled this idea and suggested that some heritable factor was involved.

Unfortunately no attempt was made in the earlier years to segregate and count the abortive grains. They were merely shelled off and planted with the normal grains. A marked deficiency in the percentage of germination was noted in these ears nevertheless.

Last season, however, four self-pollinated ears and several crosses were produced. Three of the four selfed ears showed segregation into normal and abortive grains. The fourth was an entirely normal, well developed ear. Two ears (2208-4 and 2208-7) were photographed and appear in Fig. 25.

The abortive grains are sharply distinguishable from the normal ones. They possess no trace of an embryo and no endosperm tissue has developed; they are merely shells made up of pericarp tissue. Silks are nevertheless produced on them. The abortive grains are scattered more or less evenly over the entire ear. Their distribution and their proportion to the normal grains strongly indicates that they are inherited as a simple Mendelian recessive character.

Counts were made on the three ears and the number of normal and abortive grains on each are recorded in Table IV.

TABLE IV: *Showing Segregation into Normal and Abortive Grains of Three Self-pollinated Ears*

Pedigree No.	Normal Grains	Abortive Grains	*Dev.* P. E.
2208–1	229	86	1.3
2208–4	456	161	1.0
2208–7	288	118	2.7
Total	973	365	2.8
Theoretical (3:1)	1003	335	

Among a total of 1338 grains in Table IV, 365 or 27.3% are of the abortive type. Presumably, then, we are dealing with a recessive, Mendelian factor that inhibits the formation of both embryo and endosperm.

The abortive grains occurred in a family of plants that were showing segregation into green and chlorophyll-free seedlings. It is to be expected that when the green plants of such a family are self-fertilized, a certain proportion of them will segregate in the next generation. Only four green plants (2208 (1), (2), (4), (7)) were self-pollinated and they produced nothing but pure green progenies. Four is too small a number on which to base conclusions, but it does suggest the possibility of some relation between the abortive grains and the seedlings deficient in chlorophyll.

This relation might be conceived of as a case of complete linkage between a lethal factor destroying both embryo and endosperm and another lethal factor inhibiting the formation of normal chlorophyll. Since the original F_2 generation was segregating for both the white and virescent-white seedling factors, it is impossible to judge which of the two might be concerned in such a linkage. Further tests are being planned to determine this.

There is also a possibility that we are not dealing with a case of linkage at all, but that the abortive grains are due to some physiological interrelation of the chlorophyll factors. Since, however, all the known chlorophyll abnormalities have been tested against each other and have reacted and segregated as ordinary Mendelian factors, it does not seem re sonable to suppose that they would, in themselves, have any such radical effect as to destroy both embryo and endosperm.

The relation between the abortive-grain character and inbreeding is similar to that of the other recessive characters mentioned in the first paragraph of this article. If present in a strain of maize, although they might be unsuspected, being hidden by the dominant, normal allelomorph, these abortive grains would begin to appear when the strain was inbred. This would decrease the yield of such a strain seriously. The abortive-grains could be eliminated, with some difficulty however, but if any favorable characters were closely linked with them, they too would be eliminated.

SUMMARY

Certain striking chlorophyll abnormalities are shown by breeding evidence to be distributed in several different chromosomes of maize. From this it is to be inferred that other less pronounced deficiencies of chlorophyll are distributed in a similar manner. The latter especially are common in commercial fields of corn and presumably are responsible for decreasing or limiting the productivity of the plant to some extent. They would naturally be isolated and removed in an intensive system of selective inbreeding, since they are recessive in nature. Being distributed on different chromosomes their elimination would tend also to remove some of the more favorable factors which, being on the same chromosomes, would naturally follow the defective factors in inheritance. In this manner, it is very likely that continuous inbreeding removes favorable as well as unfavorable factors from the original stock.

To succeed in a system of maize inbreeding then, it is essential to begin with the best source of material available, a source that is as free of abnormalities and defects as possible. It is probable that inbreeding of such stock might be carried out with very little loss of stature, yield or fertility and would at the same time improve the uniformity of the type.

MUTATIONS IN MUCORS[1]

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THE theory of mutations has played an increasing rôle in experimental evolution since its enunciation some twenty years ago. Sudden germinal changes, large or small in amount, have been the basis of perhaps the most fundamental work in modern genetics. It is natural that mutations should have been first sought for and found primarily in higher organisms, and in connection with the sexual reproduction which is characteristic of such forms. It became evident later that mutations could not be confined to cells associated with sexual reproduction, but, as shown by the somatic mutations[2] involved in bud sports in plants, and in similar less common phenomena in animals, they may occur in cells in which sexual processes are not involved. They have been found in lowly organized plants and animals in which nonsexual reproduction is the rule or in which sexual reproduction is not known to occur.

The mucors are a fungous group in which multiplication is brought about chiefly by nonsexual spores produced in sporangia. Sexually formed zygospores are rarely found in most forms. There are two main groups as regards their sexual reproduction:—dioecious forms and hermaphrodites. The sexual races of the dioecious forms are in the main similar in appearance, and the uniting sex cells or gametes are apparently morphologically equivalent. For this reason, the terms plus and minus have been applied to their opposite sexes instead of the terms male and female used in reference to the morphologically distinct sexes in higher forms. In many cases it has been possible to obtain a sexual reaction, called "imperfect hybridization," between plus and minus races of different species. This imperfect hybridization reaction has also been used in testing the sexual tendencies of hermaphrodites and their mutants.

It is in a species of the hermaphrodites (Mucor genevensis) that the mutations discussed in the present paper have been found. Races of this species from three different sources have been kept running in vegetatively propagated pure lines for 19 years. The species was studied in 1913 with the hope of inducing germinal changes by subjecting its vegetative growth or mycelium to various physical and chemical stimuli. Before concluding that any variation found after subjecting the mycelium to a given stimulus was in fact brought about by this stimulus, it was necessary to discover what, if any, variations the fungus would produce under normal conditions. So many variants were discovered, however, in this preliminary study, where no special stimuli were applied, that extensive investigations have not yet been attempted as to the range of variations under abnormal conditions.

METHOD OF GROWING MUCORS

The method of growing these mucors is relatively simple. To be sure that there is no doubt as to the purity of the stock with which one starts, it is desirable to obtain a culture from a single vegetative spore. This single-spore culture is grown in a test tube and, in addition to slow-germinating zygospores, produces numerous sporangia containing thousands of nonsexual spores. These sporangiospores are mixed with water and the spore mixture diluted until a platinum loop will con-

[1] A preliminary report of mutations in mucors was given in Year Book of the Carnegie Institution of Washington XII, 104–105, 1913 and presented before the Amer. Soc. of Naturalists, Dec., 1914.

SPECIMEN JARS USED IN ISOLATION CULTURES

The Dwarf true-breeding mutant is shown in the jar at the right, and on the left is shown mutant "X," an unstable mutant reverting to normal type "Y." The "Dwarf" is eleven days old "and its slowness of growth can be seen in comparison with the seven day old culture on the left. (Fig. 26.)

tain the proper number of spores as determined by examination under the microscope. The requisite number of spores are transferred with the loop to a tube of melted nutrient agar, and the agar then poured into an inverted specimen jar used as a roll tube shown in Fig. 26. By proper manipulation under the water tap, the agar is hardened, thus holding the spores uniformly scattered in a thin layer inside the tube. It goes without saying that the various steps in this process should be carried on with regard to the precautions necessary to prevent contamination with foreign spores. By the second day the spores have germinated and produced mycelial colonies which rapidly increase in size and eventually cover the available nutrient. Several hundred colonies can be readily observed in a quart sized tube.

In such an isolation culture just described, it is usual to find a few of the colonies which differ more or less in appearance from the normal growth expected for the species. The difference may be in the color or compactness of growth of the mycelium, in the lengths of the sporangium stalks, or in the size and abundance of the zygospores which are later produced, or in a

number of other characters, but most commonly in the reduced size of the colonies. The aberrant colonies may be transferred uncontaminated to test tubes before the spores are produced or their spores may be used in making a new isolation in a second roll tube. In all, somewhat over 38,000 colonies from individual sporangiospores have been inspected and a relatively large number of variants of different degrees of distinctness have been obtained. The history of nearly all of these mutants is similar in that the mutants tend eventually to revert to the normal type. Two, however, have seemed more stable than the rest.

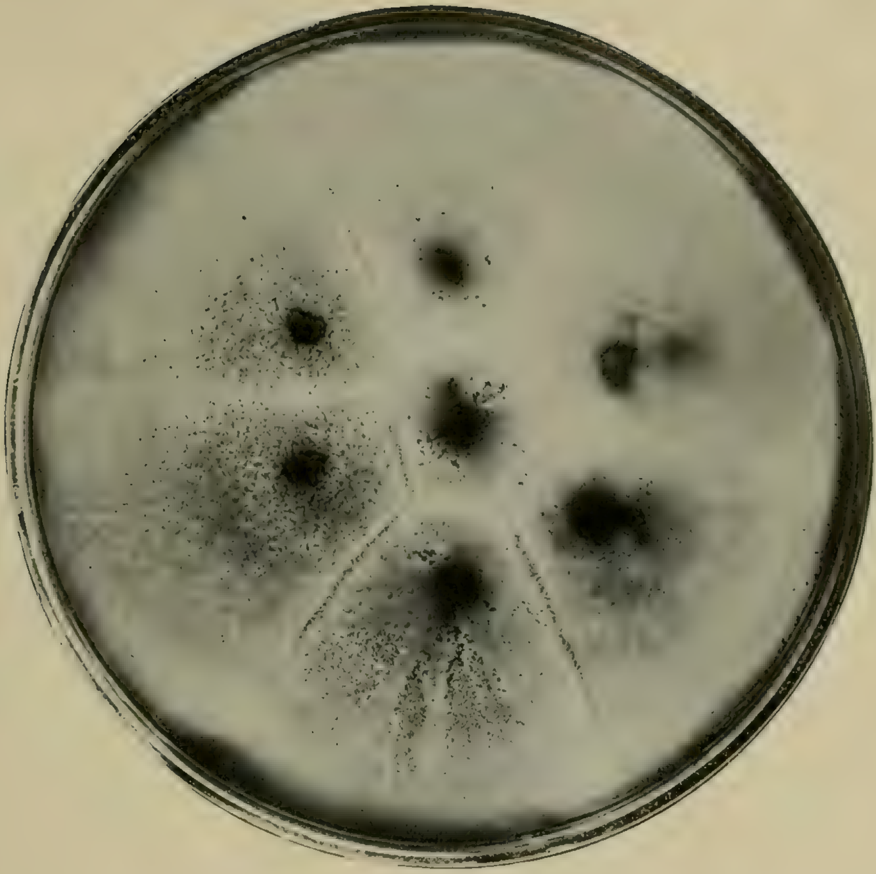
A FIXED DWARF MUTANT FOUND

A mutant which can conveniently be called the "Dwarf" was found in March, 1913 in an isolation of spores from a single test tube culture of the normal stock. Among 1015 individuals, a single colony was noticeably smaller than the rest and different from its neighbors in the density of its mycelium and the ragged edges of its growth. Transfers of the mycelium to test tubes and continued cultivation for nearly seven years on a variety of media in gross and isolation cultures make it apparent that the mutant is fixed and constant. Its characteristic appearance, in an isolation culture, is shown in the right hand tube in Fig. 26. This is eleven days old, and its slowness of growth can be seen in comparison with the seven day old culture on the left, especially with the lower colony marked "X" which had more room for extension than its neighbors. Perhaps the most striking peculiarity of the Dwarf is its lack of definitely formed spores characteristic of the group and found in all our other mutants. The mycelium is granular and readily breaks up into bits of the mycelium, so that isolation cultures from these fragments can be made, but no sporangia have ever been observed. The difference in size of the colonies in the tube photographed may be due to a difference in the size of the fragments from which they grew. The granular nature of its vegetative growth is merely a more pronounced expression of a tendency already present in the parent stock especially when grown in sugar solutions. Like the normal stock, the Dwarf also is able to take active part in alcoholic fermentation.

Zygospores, normally characteristic of this hermaphroditic species, are also entirely lacking, as might be expected from so weak a growth. For the same reason perhaps, it fails to give any sexual reaction with plus and minus races of a test dioecious species. The inhibiting effect upon growth of adjacent colonies may be noted in the photograph by their flattened outlines and the clear space between, where otherwise they would grow into contact. Instances where colonies seem to overlap are due to colonies showing through from the other side of the tube.

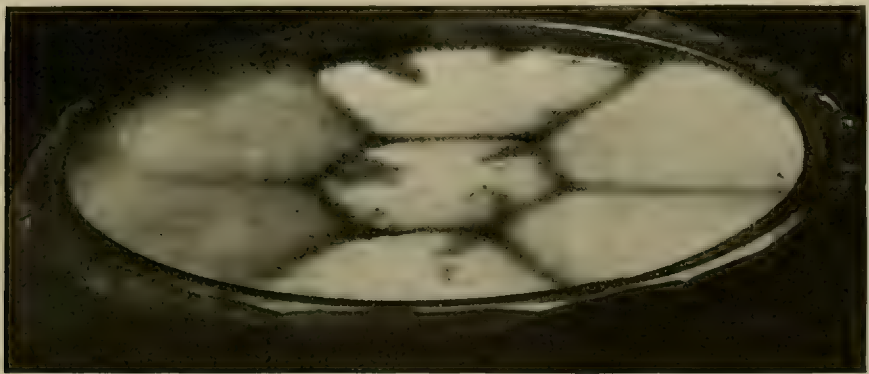
A MUTANT FROM A COLONY LACKING ZYGOSPORES

The second mutant to be considered which appears to breed true was found February 22, 1913 in a two weeks old isolation culture of 265 colonies. This single colony, labelled A1, entirely lacked zygospores which thickly dotted all the other colonies in the series. It was freed from its zygosporic neighbors, with which its sporangia were intermingled, by streaking its spores on nutrient agar in a Petri dish culture. Some of the colonies produced zygospores and were considered to be from spores of other adjacent colonies. Some were entirely free from zygospores. One of the latter was transferred to a tube culture while young and labelled A2. From A2 an isolation culture was made on March 7, and produced 4631 colonies, all of which lacked zygospores. One of these colonies (A3) was used in making another isolation culture and yielded 24 colonies again, all without zygospores. The mutitant race has been continued in test tube culture since 1913 and at the present writing has reached the 16th nonsexual generation. Tube A16 is distinctly different from other races of



PETRI DISH CULTURE PHOTOGRAPHED BY TRANSMITTED LIGHT

The small black dots are sexual spores (Zygospores); the large dark areas are places where innoculations were made. The two left hand colonies are the normal race with numerous hermaphroditic zygospores The central row of three colonies are mutant "X" with large zygospores; the two right hand colonies are mutant "D" with only an occasional zygospore or none. Mutant "X" has a plus sexual tendency and hence forms lines of zygospores in contact with mutant "D" and the normal race, both of which have a minus tendency. (Fig. 27.)



CULTURE PHOTOGRAPHED BY REFLECTED LIGHT

The same arrangement of races as in Fig. 27 above. (Fig. 28.)

this species, primarily on account of the light appearance of growth due to the lack of zygospores. The ability to form hermaphroditic zygospores did not seem to have been entirely lost in 1913, however, since on more suitable nutrient than is available in the thin layer in an isolation tube, zygospores were occasionally produced, although in very small numbers. At the present writing (February, 1920), it fails to produce zygospores on the nutrients tested.

Tests made in 1913 of the A3 generation showed that the mutant had a minus sexual tendency since it gave good reactions with the plus races of two different dioecious species. In addition, it formed a line of zygospores with the "X" mutant known to have a plus tendency. This will be discussed in a later paragraph.

That it was not entirely lacking in the plus sex was further shown by its reaction, although weak, with a minus race of one of the dioecious test species. The mutant "A" therefore cannot be considered an example of complete transformation from a hermaphroditic into a dioecious species although it may show a tendency in this direction. It may be added that the "A" mutant has recently given rise to a striking new form "F" characterized by a low, white, felted, aerial growth and a scanty production of zygospores. It has been carried to only a few generations but so far has remained constant.

The "Dwarf" and Mutant "A" are the only examples of true-breeding mutations so far investigated in the species. Further study may show that even these have the power of reverting at times. Those discussed in the following paragraphs are examples of the more common type of reverting mutations.

MUTANTS WHICH HAVE NOT REMAINED CONSTANT

In Figs. 27 and 28 are shown two mutant races, "X" and "D," which have not remained constant under cultivation. The two colonies at the left in each figure are the normal stock; the three colonies in the central row are the "X" mutant and the two colonies at the right are the "D" mutant. The photograph shown in Fig. 27 was taken by transmitted light and shows the hermaphroditic zygospores as small black dots; the large dark areas are the places where the inoculations were made. The photograph in Fig. 28 was taken by reflected light and shows better than does Fig. 27 the differences in habit of growth between the three races.

Mutant "X" has a lower, whiter growth than the normal race. Its sporangia, as well as its zygospores, are less abund nt and the latter are somewhat larger than normal and tend to be arranged in groups, which often form dark sectors radiating from the point of inoculation. Its greatest interest lies in the fact that it forms a line of zygospores with the normal race on its left as well as with the "D" mutant on the right, as shown in Fig. 27 and less well in Fig. 26. It was this ability to form lines of zygospores with adjacent colonies that attracted our attention to its first appearance in an isolation culture of a strongly zygosporic mutant consisting of 41 colonies. Ordinarily, as mentioned under the Dwarf mutant, colonies exercise some inhibitory action toward one another which retards their growth on adjacent sides and prevents their meeting when the nutrient is thin, as in an isolation culture. The inhibitory action is absent and the colonies meet when they are of opposite sexual tendencies. This seems to be the case with mutant "X" and its parent race. The normal race (called "Y") gives a strong reaction with plus test races of dioecious species and is therefore a hermaphrodite with a minus tendency, while mutant "X" gives a strong reaction with minus test races and is therefore a hermaphrodite with a plus tendency. In a similar way mutant "A" and mutant "D" have been shown to be hermaphrodites with a minus tendency. Mutant "D" formed at first a yellowish dense growth almost entirely devoid of zygospores. By continued cultivation

it seems to have lost its distinctive characteristics.

The history of the mutant "X" is given in the Table on page 284. In a series of isolation cultures in 1914 the mutant bred practically true with only three possible reversions to normal out of nearly 1500 colonies. In the 17th generation in 1916 the mutant seemed to have entirely reverted. It was regained, however, from a culture of an earlier generation and by a series of isolations its ability to throw offspring like itself was again increased. In 1917, after a few generations grown in test tube cultures, the mutant again appeared to have entirely reverted to the normal parental type and could not be regained.

At two other times in this species have mutations been observed which form lines of zygospores with the normal stock: once in an isolation culture in 1916 and once ten years earlier at the germination of the zygospores. Other mutants tested have shown a minus tendency like the parent stock.

A STRIKING MUTANT FORM

One of the most striking mutant forms appeared as a small warty colony in an isolation culture of 949 colonies. A microscopic examination showed that the colony was composed exclusively of a mass of yeast-like cells somewhat similar to those that are formed when the normal mycelium of this species is submerged in a sugar solution and takes part in alcoholic fermentation. An isolation made from this original colony gave predominatingly yeast-like colonies with only a few normal colonies. At first no filaments were found and the accumulation of yeast-like cells formed a warty mound above the surface of the agar. Often the drops of water exuding from the agar in running down the inside of the tube would carry with them the yeast-like cells of the mutant and form streaks of secondary "yeast" colonies. Later each colony gave rise to a few normal filaments, the further rapid growth of which filled the culture and covered over the warty mutants. During April, 1913, a series of four isolation cultures were made of the "yeast" mutant, resulting in 721 "yeast" colonies to 423 early reverting colonies. The records were taken on the fourth or fifth day. Eventually even the typical "yeast" colonies reverted. During August and September 1914, an attempt was made to regain the "yeast" condition from five test tube cultures which had originally contained "yeasts." A total of 5,995 colonies were examined from these tubes, but the "yeast" mutant could not be recovered. Reversion in this mutant takes place regularly in the mycelium. In other mutants reversion is apparently more common at the formation of spores.

The "X" and the "A" mutants are of especial interest from the standpoint of sexual differentiation. On account of its freedom from zygospores and its relatively strong reaction with plus test races, mutant "A," if found alone, would appear to be an unmated minus race of some dioecious species. Its very weak reaction with certain minus races might easily be missed. If mutant "X," which is a mutant in the plus direction, had been likewise devoid of zygospores and found to conjugate with mutant "A," as it actually did, one would have felt justified in considering "X" and "A" as the mated plus and minus races of a dioecious species. It is possible that in nature dioecious races may have arisen from hermaphrodites through mutations which have carried the sexual differentiation farther than was observed in our two mutants.

Burgeff has obtained mutations in the dioecious mucor genus Phycomyces. The mucors are multinucleate, normally without cross walls in the vegetative mycelium. Mutations, he considers, affect only a part of the nuclei. The more rapid division of the normal nuclei in these mixo-chimeras, as he calls the variants, would account for the reversions which almost always take place. It is possible that our reverting mutants in the hermaphroditic *Mucor genevensis* are in fact

mixo-chimeras, and that it may be possible to obtain them in pure races as Burgeff has done in Phycomyces through the germination of the zygospores.

The individual mutants considered in the present paper are representative of many variant forms that have arisen by mutation in the nonsexually propagated races of *Mucor genevensis*. They add to the evidence, already obtained from other groups, that mutations are not restricted to processes involved in sexual reproduction.

HISTORY OF "X" MUTANT

(Y represents colonies normal to X)

September, 1913	X1 First colony of mutant X	
" "	X2 Isolation culture	X and Y types present.
" "	X3 Test tube culture of an X colony from X2	
Aug.–Sept., 1914	X4 Isolation from X3	96X : 119Y
" " "	Y5 Tube from a Y colony of X4	
" " "	X5 " " " X " " "	
" " "	Y6 Isolation from Y5	0X : 481Y
" " "	X6 " " X5	512X : 3Y (?)
" " "	X7 " " X6	625X : 0Y
" " "	X8 " " X7	316X : 0Y
	X9–X13 Series of test tube cultures	
February, 1915	X14 Isolation from X13	115X : 3Y
	X15 & X16 test tube cultures	
Feb.–April, 1916	X17 Isolation from X16	0X : 204Y
" " "	Xa12 " " X11	5X : 56Y
" " "	Xa13 " " Xa12	16X : 1Y
" " "	Xa14 " " Xa13	678X : 3Y
	Xa15–Xa17 Test tube cultures	
July, 1917	Xa18 Isolation from Xa17	0X : 207Y
" "	Xa17 " " Xa16	0X : 473Y

A RANDOM TEST IN THE THEORY OF PROTECTIVE COLORATION

FREDERICK ADAMS WOODS

UNTIL Abbott Thayer had developed the theory, no one supposed that the bright and often dazzling colors of birds and other animals were in many instances a device to render these creatures not *more* but *less* conspicuous. Rem mbrance of the wide introduction of camouflage and dazzle-painting during the late war will doubtless do much to convince the skeptical of the essential truths of Thayer's theories—discoveries which were in their essence optical, and did not necessarily involve learned discussions in natural history.

In Thayer's elaborate and magnificent book on the subject of protective coloration, a large number of black-and-white, and sometimes colored, pictures are presented by way of proof, but inasmuch as the authors[1] have been accused of being over-zealous in finding support for their theory, some impartially, and accidentally acquired evidence is not without interest.

Such evidence can now be supplied by museum material. In the old days, natural history museums were dismal places to visit. Stuffed animals, usually moth-eaten, were kept in dark and dusty cases, scientifically labeled and seldom seen. Now we have in many of the larger museums beautifully and accurately constructed artificial backgrounds as suitable settings for the wild life exhibited (as if in nature) and surrounded by natural objects—leaves, twigs, stones, and sand.

The four pictures, here presented, were taken in the Museum of the Bos-

[1] Thayer, G. H. and A. H., "Concealing Coloration in the Animal Kingdom," 1909.

PIPING PLOVER ON SAND AND ROCKS

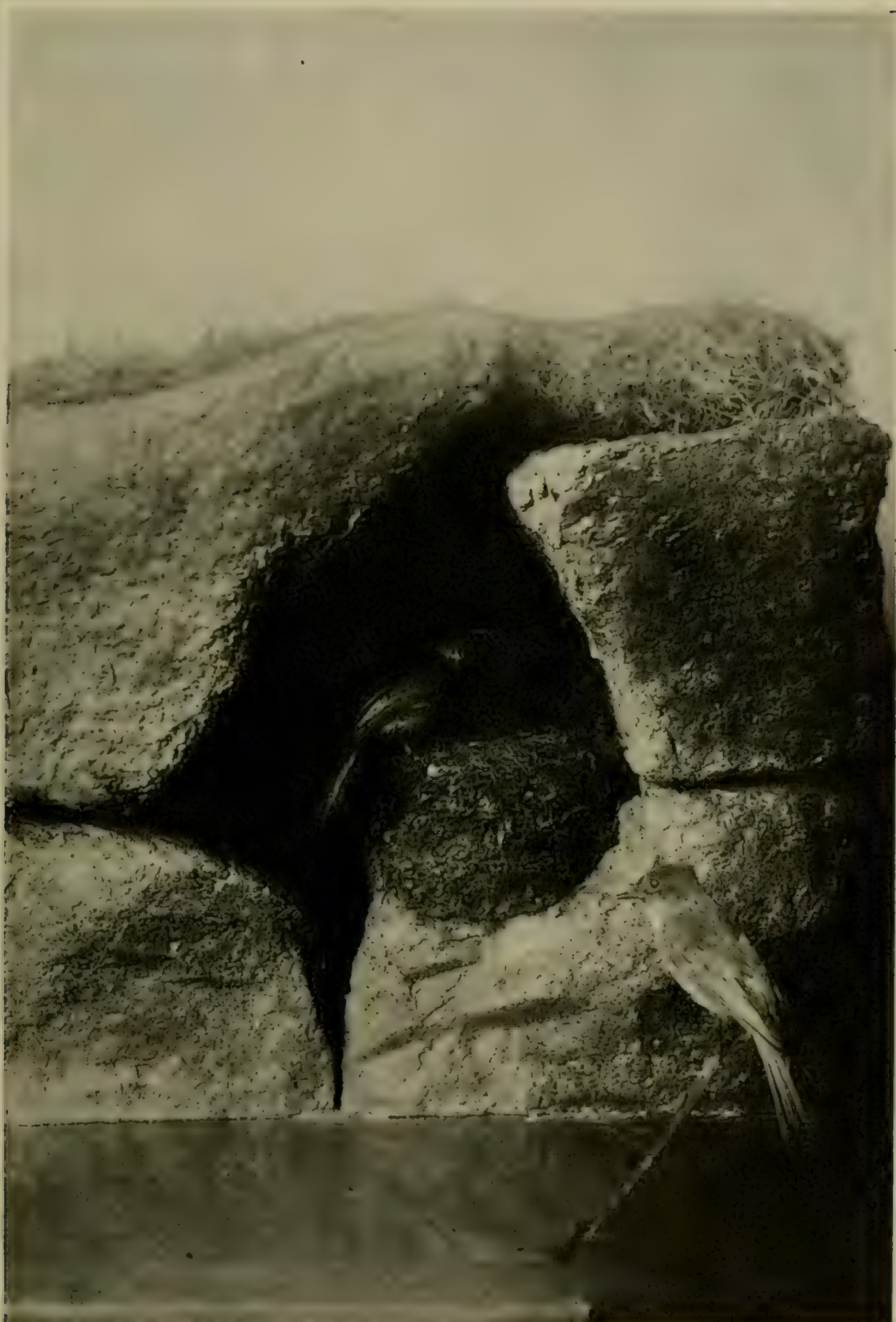
Piping Plover are well concealed by their white and pale grey coloration. The eggs resemble stones and are hard to recognize. The dark band on the neck of the bird in the centre of the picture resembles the shadow on the adjoining rock. (From an exhibition case in the Boston Society of Natural History.) (Fig. 29.)

ton Society of Natural History, as a confirmatory test—one that should be presumably impartial, since no rearrangements were made. The birds were taken just as they were placed in the cabinets, except that the frames as a whole were tipped at an angle, in order to facilitate the photographic work. All of these except the Phoebe are also represented in Abbott Thayer's book.

One of the birds, a whippoorwill, is artificially outlined against the white sheet used as a background. The head of a plover is easily detected for the same reason, but whenever the birds appear against their natural backgrounds their concealment is excellent and the test indicates that the Thayers did not strain a point by arranging their birds in especially favorable attitudes.

A WELL CONCEALED BIRD

This bird, a nighthawk, is exceedingly well concealed, its yellowish brown plumage merging with the dead leaves and twigs. The eggs are spotted and colored but are not invisible. (From an exhibition case in the Boston Society of Natural History.) (Fig. 30.)



A PHOEBE

This bird is a good example of protective coloration. It builds its dark green nest among dark green rocks near the water and its color resembles its surroundings. (From an exhibition case in the Boston Society of Natural History.) (Fig. 31.)

A WHIPPOORWILL

The female on the ground is almost invisible, its color closely resembling the dried leaves. Its eggs are white, in contrast to those of the nighthawk. The white background here is artificial. (From an exhibition case in the Boston Society of Natural History.) (Fig. 32.)

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

VOL. XI, NO. 7 SEPTEMBER-OCTOBER, 1920

CONTENTS

The JOURNAL OF HEREDITY is published monthly by the American Genetic Society.
Publication office, 450 Ahnaip Street, Menasha, Wis.
Editorial and general offices, Washington, D. C.

The JOURNAL OF HEREDITY is published by the American Genetic Association for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $3.00, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $3.00 a year, foreign postage extra; price of single copies, 25 cents.

Application has been made for entry as second-class matter at the postoffice at Menasha, Wisconsin.

Date of issue of this number, March 23, 1921

COMPARATIVE TEST ROWS OF LARGE, INTERMEDIATE AND SMALL NURSERY TREES OF WASHINGTON NAVEL ORANGE

Citrus orchards show great variation in the yield of different trees in the same orchard. Nursery trees of the same age, ready for sale, often exhibit great diversity in size. Does this variation mean anything in bearing qualities? To determine if these differences were of any importance, a test was begun at the Citrus Experiment Station, Riverside, California in 1917. A row of large trees is shown at the right in this photograph, a row of small trees at the left, and a row of intermediate trees at the extreme left. They were planted in June 1917 and photographed May 1919, still retaining their relative sizes. (Frontispiece.)

THE IMPROVEMENT OF ROOT-STOCKS USED IN FRUIT PROPAGATION

H. J. WEBBER
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FOR many years it has been clearly recognized that the root-stock has an important influence on the scion and on the quantity and quality of the crop produced, yet very little experimentation has been devoted to root-stock problems or to the determination of the best stocks to use.

It is true that these matters are discussed at almost every convention of fruit growers and much information based on experience has been recorded. In general, the discussion and indeed all consideration has been limited to the effect on different varieties of certain root-stocks which are themselves usually very variable species. In citrus fruits, for instance, all consideration has been limited to a discussion of whether one should use sour orange (*Citrus aurantium*), sweet orange (*Citrus sinensis*), grapefruit (*Citrus grandis*), lemon (*Citrus limonia*) or trifoliate orange (*Poncirus trifoliata*). These species are not composed of stable, uniform groups of individuals but are exceedingly variable, each containing many hundreds of different types. No attention has been given, however, to the reactions that may be expected from the use of different types within the species. The same statement applies equally well to the various stocks used for apples, peaches, pears and similar fruits.

It seems clear to the writer that this is fundamentally wrong, and yet before any generally accepted policy can be overthrown, evidence must be found definitely to show that it is wrong. The writer for the last five years has been engaged in the study of this problem in connection with citrus fruits and the evidence obtained will probably apply just as definitely to other fruits as to citrus. The following is an outline of the experiments and results of a study of this problem with different varieties of citrus.[1]

VARIATIONS IN NURSERY AND ORCHARD TREES

Citrus orchards show great variation in the yield of different trees in the same orchard. This variation is known to be universal even in orchards of the same variety that have been planted with the best obtainable trees. Some orchards are quite uniform, however, while others are exceedingly variable. Batchelor and Reed have shown[2] that the trees in the most uniform groves will vary from 30 to 40 percent of the mean.

Mr. A. D. Shamel and his associates of the U. S. Department of Agriculture have emphasized the relation of the character of the buds used in propagation to this variability in the orchard and have rightly urged the importance of choosing buds for propagation from uniformly high yielding trees known to produce only fruits of standard type.[3] Is this the only factor involved?

It is a well known fact that nursery trees as they are normally grown when two years old and ready for sale exhibit great diversity in size, the trunks frequently ranging from 3/8 inch to 1½ inches in diameter. Does this variation in size of trees of the same age

[1]Webber, H. J. Selection of stocks in citrus propagation, California Agricultural Experiment Station Bulletin 317, January, 1920.

[2]Batchelor, L. D. and Reed, H. S. Unpublished investigations.

[3]Shamel, A. D. *et al.* Citrus fruit improvement, U. S. Department of Agriculture Bulletin 623, July 22, 1918; Bulletin 624, July 25, 1918; Bulletin 697, Sept. 27, 1918 and Farmers' Bulletin 794.

WASHINGTON NAVEL ORANGE TREES

These are average-sized trees chosen from the test rows of large, medium and small nursery trees planted in the orchard in June 1917 and photographed May 1919. They have now been in the orchard three years and still retain their comparative differences in size, each grade, from the smallest upward, being about two years behind the next larger one in development. (Fig. 1.)

mean anything or is it purely accidental? All of these trees are ordinarily sold and planted. Probably these differences in size are due to the same or similar causes as those responsible for the differences in size in bearing orchard trees.

A nursery grown at the Citrus Experiment Station for experimental purposes was planned with the idea of producing as uniform trees as possible. The sweet seedling stock used was thus selected when it was planted in the nursery, many of the small trees being discarded. Through the kindness of Mr. Shamel, the buds used for propagation were taken from record trees of standard type in order to further insure uniformity. Valencia and Washington Navel oranges, Marsh Seedless grape fruit and Eureka lemon were the varieties grown. When this nursery was two years old and ready for orchard planting the trees were found to show the same variations in size of buds that have been referred to as being universally present in ordinary nurseries. Had buds been taken indiscriminately from ordinary trees this variation would have been passed by as normal. As it was, this fact lead to a test of the different sizes of trees to determine, if possible, whether these differences in a nursery were of any importance in growing an orchard. Eighteen large, eighteen small and eighteen intermediate sized budded trees of each variety were selected and planted in comparison rows in the variety orchard at the Citrus Experiment Station, Riverside, California. These trees were all dug "bare root" to see that the roots were normal and not injured or diseased. All trees used in the experiment were normal and thoroughly healthy so far as could be determined. They were planted in the orchard in June, 1917. The severe heat coupled with "bare root" planting injured so many of the Eureka lemons that this variety was eliminated from the experiment. The Navels, Valencias and Marsh Seedless grapefruit stood the transplanting very well.

These trees have now been in the orchard three years and are five year old buds. They still retain the same comparative difference in size just as markedly as when they were transferred from the nursery. The large trees retain their lead and are still large. The intermediate are still intermediate in size and the small are still small. After two years in the orchard the small trees were about the same average diameter that the intermediate trees had when they were transplanted and the intermediate sized trees after two years in the orchard were about the same average diameter as the large trees when they were transplanted. Each grade is thus about two years behind the other in development. (Compare Frontispiece and Figs. 1 and 2.)

To get some indication of the comparative average size of the tops of the different groups, the top diameter of each tree was measured east and west, north and south and the height from the lowest branch to the top of the foliage. These measurements for each tree were multiplied together to give the volume of the cube that would enclose the top. The averages of these figures for each group in each variety are given in the following table.

Average Comparative Size (in cubic inches) of Tree Tops, as Indicated by Product of East and West Diameter x North and South Diameter x Height from First Branch to Top.

	Large	*Intermediate*	*Small*
Navels	54,174	20,185	12,541
Valencias	29,003	15,606	12,953
Grapefruit	26,343	15,827	10,642

While admittedly such figures are not exact measures of the top volume, they are believed to represent fairly accurately the comparative sizes of the trees in each group.

FACTORS CAUSING VARIATION

To what factors could this variation be due and is it of any importance in citrus propagation? A difference in the soil or in the nutrition available might cause variation in size but this cannot be the main cause of the varia-

tion in size of these trees as they showed the difference in the nursery and continue to show it three years after transplanting into the orchard. In the orchard they are planted close together on uniform soil and are treated alike, so the difference cannot be attributed to local soil condition or nutrition.

Is the difference due to the character of the bud union? The buds seem to have healed nicely in all trees used and exhibit no characters indicating that the formation of a poor union could be considered as causing the difference.

Is it due to the roots having been injured thus resulting in dwarfing the tree? The roots were all examined when the trees were transplanted and all were found to be healthy and uninjured. Any injury or disease contracted since the trees were transplanted could not be limited to the small tree rows only.

Is it due to the kinds of buds used? All that can be said regarding this is that the buds were carefully selected from trees of known record and standard type. It does not seem that the difference is to be explained in this way although this possibility cannot be entirely eliminated.

IMPORTANCE OF SEEDLING STOCKS

The only other factor that is likely to be the cause of the variation is the influence of the stocks used. The sweet orange stock used was merely ordinary sweet orange seedlings grown from unselected seed, the only extra precaution taken being merely to discard the smallest seedlings when transplanting from the seed bed. About 15 percent of the total number of seedlings were discarded at that time. The universal custom pursued at present is to use either sweet, sour, grapefruit, lemon or trifoliate orange stock without reference to any particular kind within these great groups. Are the variations within the ordinary lots of sweet and sour orange seedlings sufficiently great to be assumed to account for these variations in size of nursery trees? Fortunately some evidence has been secured bearing on this point.

In 1915 the writer, with the help of Mr. W. M. Mertz and Mr. E. E. Thomas, made an examination of one sour orange nursery and selected sixteen seedlings that appeared to show different characters. At the same time in the same nursery four different types were selected in a bunch of sweet seedlings. A more detailed examination would doubtless have revealed many more types but the only object in view at that time was merely to add "freaks" to our variety orchard. Buds were cut from each of these seedlings and two sour orange stocks were budded with each type. The trees from these buds are now five years old from the bud and have been set in the variety orchard for three years. All of the types selected present marked differences in size, foliage, character of branching and the like. The good vigorous types in the case of the sour orange selections are five times, or more, larger than the slow growing dwarf types. An indication of this great difference can be obtained by comparing the photographs of three typical trees shown in Figure 3, A, B and C. A represents a fine, vigorous, growing sour orange type while B and C represent slow growing, probably dwarf types. Similar differences in leaf size and shape are also exhibited. Compare for instance the size of leaves in A with those of C, which are both healthy trees. Two trees out of 16 of the sour orange types selected have lost the typical aroma of the sour orange, so far as the leaves are concerned. The four types of the sweet orange also differ in similar way in size and foliage characters.

The great extent of this range of variation within the different species is shown equally as well by the large number and range of the named varieties that are grown.

The sweet orange and sour orange seedlings grown for stock purposes are usually or at least frequently grown from seed, of unknown origin, and taken from different trees. We are not dealing with a homogeneous lot but with lots in which every individual differs from every other individual and

MARSH SEEDLESS GRAPEFRUIT TREES

Average-sized trees chosen from the test rows of large and small nursery trees planted in the orchard June 1917 and photographed May 1919. These, too, have continued to show the same comparative difference in size as they had when in the nursery. (Fig. 2.)

yet our policy has uniformly been to use all—good and bad alike—for propagation. Is it any wonder under these conditions that our trees though grown from the best selected buds should be variable in the groves?

The Eureka lemon on a trifoliate stock is very markedly dwarfed while Valencias grow to good sized trees. The Florida rough lemon is usually a good stock while the Chinese lemon is commonly recognized as a poor stock. Different reactions on the bud caused by the influence of different stocks are well known to exist. When therefore such marked differences are found to exist in the sour and sweet orange seedlings that we are using as stocks, is it any wonder that the budded trees in the nursery, even when selected buds are used, should grow differently and produce large and small trees and that these differences should continue to exist when the same trees are grown in the orchard?

The evidence now available very strongly points to the conclusion that the differences in size of nursery trees such as those taken for the experiment outlined are mainly to be attributed to the different nature of the seedling stocks used. If this is true, and it is entirely in line with the evidence as well as with common sense and judgment, it is certainly an element of fundamental importance in citrus propagation.

I would be remiss in caution if I did not call attention to the fact that one very important link in the chain of evidence is yet lacking, that is, the growing of good buds on known stocks of these various types to prove that certain ones give better growth than others. This evidence, however, is partially supplied by our known ex-

A B C

DIFFERENT TYPES OF THE SOUR ORANGE

A, a good, typical form with vigorous growth and excellent foliage and branching characters, selected as a good stock type; B, a type of medium size and rapidity of growth; C, a slow growing dwarf type with small leaves. (Fig. 3.)

perience of the reaction of buds on different stock such as referred to above.

DIFFERENCES INHERENT IN STOCKS

Will the small trees continue to remain small? Certainly the evidence thus far indicates that this is very likely. The probabilities are that they will. Dr. Reed of the Citrus Experiment Station carried out a series of experiments[4] with a considerable number of sunflower plants that has a bearing on this phase of the problem. In this group of sunflowers, exact measurements of height were made of each plant every week from the time it was a few inches high until it reached maturity. The analysis of the data of growth obtained showed a well marked tendency of the plants to retain their same relative rank as to size throughout the period of growth. Plants which were small at maturity were generally small in the beginning and those which were large at maturity had a well marked superiority from the start. The evidence indicated that height and vigor of growth were determined not by chance but by some definite inherent factor in the plant itself. The same is doubtless true with citrus seedlings of the various species such as those used for stocks and if the cause of the different sized nursery trees is to be attributed primarily to the influence of these stocks as seems probable, then it is also probable that the difference is due to causes inherent in the different stocks and that the same relative rate of growth and size will be maintained in the majority of the plants.

While the evidence is yet incomplete, we are probably justified from what evidence we have in speculating somewhat as to what this means in our fruit industries. Frequently, almost every tree in an orchard will be a fine good grower and fruiter, giving a uniform orchard. Again, an orchard equally well handled may be very ununiform having some good trees, some poor ones and some of intermediate character. This difference could be accounted for by assuming that the good orchard chanced to be from trees grown on stock that happened to come from seeds of good stock trees or that they had been taken from a nursery where in filling the order of size only the large trees had been dug, which would be the ones naturally on good vigorous stocks. The remaining slower growing trees from such a nursery would ultimately reach the required size and be sold and planted in another orchard which would likely give an uneven orchard with good and bad trees.

Some growers will be inclined at first to think that their experience is contrary to this and that the small tree is more likely to be fruitful while the largest trees are likely to spend their energy in vegetative growth. They must remember that this experience was gained before buds of selected type were used. Mr. Shamel has demonstrated that some types of our varieties tend to produce rapid growth and little fruit while others produce good growth and are fruitful. The results the writer is explaining, however, were obtained with the use of buds taken from the best fruiting types and it is not likely that this type will be changed materially by the stock other than in size of growth.

NEW NURSERY METHODS SUGGESTED

If the results of these experiments are correctly interpreted by the writer it means that our nursery methods in citrus propagation must be materially changed.

(1) We must no longer grow merely sour stock or sweet stock and the like. The process must be carried farther and good stock varieties of sour orange and sweet orange must be discovered and named as stock varieties and every nurseryman should then use seeds from these varieties known to produce good stock seedlings. The trees of these varieties from which seeds are to be

[4]Reed, H. S. Growth and variability in Helianthus. American Journal of Botany, Vol. 6, 1919, p. 252.

TWO TYPES OF FRENCH CIDER APPLE TREES

The tree at the left (Marechal) is a small, slow growing variety; the one at the right (Julien de Paulmier) is a large vigorous growing variety. Both of these trees are growing in the U. S. Department of Agriculture's orchard at Arlington, Va., and they are of the same age and on same stock, indicating that the same variation in size applies to other varieties than citrus. (Fig. 4.)

taken to grow stocks must be planted in isolated places so they will not be crossed with other varieties.

(2) Good policy will doubtless dictate that all small seedlings be discarded when transplanting from the seed bed into the nursery. Doubtless nearly 50 percent of the seedlings should be discarded at this time. The writer believes that a severe culling of the seedlings may unhesitatingly be recommended.

(3) In budding a nursery no inferior seedlings found in the nursery should be budded. Doubtless we will hereafter carefully inspect the seedlings just before budding and cut out all inferior ones to save the expense of budding them.

(4) When the budded trees reach the age for transplanting into the permanent orchard only the good, vigorous, growing ones should be used.

The writer assumes that hereafter only buds from trees of known good record and of standard type will be used in propagation. This is already recognized as the only correct and safe policy.

VARIATIONS IN APPLE STOCKS

The evidence secured with citrus varieties discussed above doubtless applies equally well to other fruits such

as the apple. In Australia and South Africa Northern Spy roots have been found to be resistant to the woolly aphis, and apple varieties are now largely propagated on this variety.[5] Professor J. K. Shaw has recognized the importance of this problem and has conducted extensive experiments in the attempt to grow apple trees on their own roots.[6]

Apple varieties are largely grafted on the French crab or cider apple stocks, the seeds or plants of which are obtained in large numbers from France. Several years ago a considerable number of the different types of these cider apples were selected in France by Professor Alwood and two trees of each of these different types are now growing in the variety orchard of the U. S. Department of Agriculture at the Arlington Farm near Washington, D. C. In November, 1919, the writer had the privilege of making observations on these different types in company with Professor L. C. Corbett and Dr. D. N. Shoemaker, horticulturists of the Department. The variations in the different types are fully as extreme as those found by the writer to exist in citrus fruits. These trees are of the same age and planted on comparatively the same soil and yet some of them are dwarfs while others are giants. As an illustration the two trees of the Julien de Paulmier are much larger and more vigorous than those of the Marechal. Photographs, of the same comparative size, of trees of these two types were made at the writer's request by Dr. Shoemaker and are reproduced in Figure 4. Seedlings grown from fruits of the Marechal could scarcely be expected to give the same results when used as stocks as seedlings from the Julien de Paulmier. Yet if the writer is correctly informed the seed we use in growing apple stocks are likely to be taken from many different types which are probably as markedly different from each other as are these two. We may desire to use a dwarf stock in some cases and a giant stock in other cases but certainly we should know what we are using.

In the propagation of grapes the specialization has been carried much farther and here a great fund of information has been obtained showing that with certain varieties only certain hybrid stocks will give good results and that on some soils only certain stocks may be successfully employed.

In fruit industries where the trees may grow for many years, possibly even for a century or more, and where continued success depends as much on the stock used as on any other single factor, is it too much to require that the stocks used should be of known quality? The writer maintains that all trees should be propagated on selected stock varieties of known origin and kind.

[5]Cole, C. F., in Journal Agriculture Victoria, Vol. 9, 1911, p. 338.
[6]Shaw, J. K. The propagation of apple trees on their own roots. Massachusetts Agricultural Experiment Station, Bulletin 190, 1919.

FOR THE HARD-OF-HEARING

It is estimated that one person in every 1500 population is deaf, and that out of this number one-third are of school age. Any hard-of-hearing person may secure literature that may prove helpful, by addressing the Volta Bureau, 1601 35th St., N. W., Washington, D. C. The Bureau does not give medical advice, has no medicines or instruments for sale, and does no teaching.

INHERITANCE IN CROSSES OF DAIRY AND BEEF BREEDS OF CATTLE

II. On the Transmission of Milk Yield to the First Generation.[1]

JOHN W. GOWEN
Agricultural Experiment Station, Orono, Maine

FOUR main problems are of particular interest to those students of genetics who are interested in the economic aspects of inheritance in cattle. These four problems may be stated as: (1) the inheritance of milk yield, (2) the inheritance of the butterfat concentration in the milk, (3) the inheritance of the duration of time during which the milk flow is maintained, and (4) the inheritance of the degree and kind of fleshing.

Two methods of approaching these problems are possible. The first consists in analyzing the more or less complete records which are in existence. The second consists of making definite controlled matings to determine the inheritance of the desired characters. The Biological Laboratory of the Maine Agricultural Experiment Station is approaching these problems along both of these lines. The results herein described deal chiefly with the second mode of approach.

The definite, controlled matings to produce the animals necessary for the analysis of these problems were begun in 1913 under the direction of Dr. Raymond Pearl. At the beginning of the war in 1917 the author took over the direction of the work and the analysis of the accumulating data. All the credit for the inception and organization of the breeding experiments consequently belongs to Dr. Pearl. The manner of approaching the solution of the data are the author's own and he alone is responsible for the conclusions drawn.

In 1917 certain of the results of these matings on inheritance in milk production were presented in the Journal of Agricultural Research[2]. The material given herein represents the accumulations of data since that date.

MILK PRODUCTION AS MEASURED BY AGE

It has been shown by the work of this laboratory that milk production for the four main dairy breeds changes in a definite manner with age. This change is described by logarithmic functions whose equation may be determined. When these logarithmic curves are compared it is found that the relative increase and decrease of the milk yield of the different ages is nearly the same for each of the three dairy breeds—Jersey, Guernsey and Holstein-Friesian. This consistency of the effect of age changes on the milk yields of the different breeds allows the correction of their milk yields and those of their crossbred offspring by the same set of correction factors determined as the mean for the three breeds Jersey, Guernsey and Holstein-Friesian. Whether or not the milk production of the Aberdeen Angus follows the same law as the dairy breeds is not known although there is a large amount of presumptive evidence that it does. In lack of final evidence all records for the milk yield of the Aberdeen Angus cows were corrected by the same set of corrections as those for the dairy breeds.

The age of two years has been chosen as the basis on which the records have been corrected. Thus if the crossbred daughter has lactation records at say two years, three years four months; and four years six months; the record

[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 135.

[2] Gowen, John W. 1918. Studies in Inheritance of certain characters of crosses between Dairy and Beef Breeds of Cattle. In Journal Agr. Research, vol. XV, No. 1, p. 1–57.

for three years four months is corrected to the expected record at two years, and the four years six months record to the expected record at two years. These three records are then summed and the average taken. This average is the record used as the milk production of the crossbred. These average records have been used as the measure of the cow's milk production because the work of Gaven[3] on British Holsteins and of this laboratory on the Jersey[4] has shown that the mean of two or more lactations is a better measure of a cow's capacity as a milk producer than is the record of one lactation. These records have been brought up to the date of May 1, 1920.

The milk yields for the dams of the crossbreds are obtained in a similar manner to those for their crossbred daughters.

THE SIRES' POTENTIAL MILK PRODUCTION

The records for the sires Taurus Creamelle Hengerveld and Lakeland's Poet are obtained as follows. The records of all daughters of these sires from dams of their own breeding are obtained in a similar manner to that described for the crossbred females. These records showing the milk production of each daughter of a given sire, other than crossbred, are then summed and the mean taken. This mean is used as the sire's potential transmitting ability. The measure used is consequently the progeny performance test for the hereditary composition of the sire for milk production.

The composition for milk production transmission of the Holstein-Friesian bull, Delva's University De Kol, where no pure offspring are available is that of Taurus Creamelle Hengerveld. It is realized that the use of this milk production to describe the transmitting ability of Delva's University De Kol is open to serious criticism. No purebred offspring are available from which an accurate test of this bull's composition could be made. In view of this contingency two fairly strong arguments support the choice of Taurus Creamelle Hengerveld's transmitting ability to represent that of Delva's University De Kol. The bulls are of the same breed. The dam of Delva's University De Kol, Delva Johanna De Kol had a milk yield closely resembling that of Taurus Creamelle Hengerveld's potential yield, as may be seen by a comparison of the sire's curve in the second graph of Figure 14, with the dam's curves of the third graph for the same figure.

Likewise the daughters of the sire of Delva's University De Kol, Johanna Lad Manor De Kol 41913 were similar in milk production to those of Taurus Creamelle Hengerveld. These facts consequently make it seem altogether probable that the milk transmitting capacity of Delva's University De Kol is correctly represented.

The transmitting qualities of Kayan, the Aberdeen Angus bull, were taken as the mean corrected two years old records of the purebred herd of Aberdeen Angus cows. The use of this record for Kayan can only be defended on purely *a priori* grounds. Until such time as his daughters come in milk this procedure will be subject to criticism. Kayan's pedigree does lead to the belief that his milk transmitting record has been correctly represented in the diagrams illustrating these data.

Figure 14, first graph, shows the milk record of Crossbred No. 1 on a monthly basis corrected to the age of two years. This record is shown by the solid line (————). The mating to produce this crossbred was a Jersey bull, Lakeland's Poet 102603, bred to a Holstein-Friesian cow, Pauline Posch 81048. The milk production of the dam Pauline Posch, on a monthly basis corrected to the two year age expectation, is given by the dotted line (............). The expected poten-

[3] Gavin, William. 1913. Studies in Milk Records. On the Accuracy of Estimating a cow's milking capability by her First Lactation Yield. In Jour. Agr. Sci., vol. 5, pt. 4, pp. 377–390.

[4] Gowen, John W. 1920. Studies in Milk Secretion. V. On the Variation and Correlations of Milk Secretion with Age. In Genetics, vol. V, no. II, pp. 111–188.

JERSEY SIRE OF CROSSBRED NO. 1

Lakelands Poet, 102603, bred to the Holstein-Friesian dam shown below produced the crossbred cow shown on the opposite page. This sire transmitted the quality of low milk yield. (Fig. 5.)

HOLSTEIN-FRIESIAN DAM OF CROSSBRED NO. 1

Pauline Posch, 81048, whose milk yield was uniformly higher than that of her crossbred daughter. Her record is represented by the dotted line in the top graph of Fig. 14. (Fig. 6.)

CROSSBRED NO. 1

This crossbred is from the Jersey and Holstein-Friesian parents shown on the opposite page. It will be noted that the shape of the nose and body of the crossbred resemble the Holstein-Friesian parent, while the size of body and udder resemble the Jersey parent. In the top graph of Fig. 14, compare the records of milk production of the offspring with that of her parents as explained in the text on page 301. (Fig. 7.)

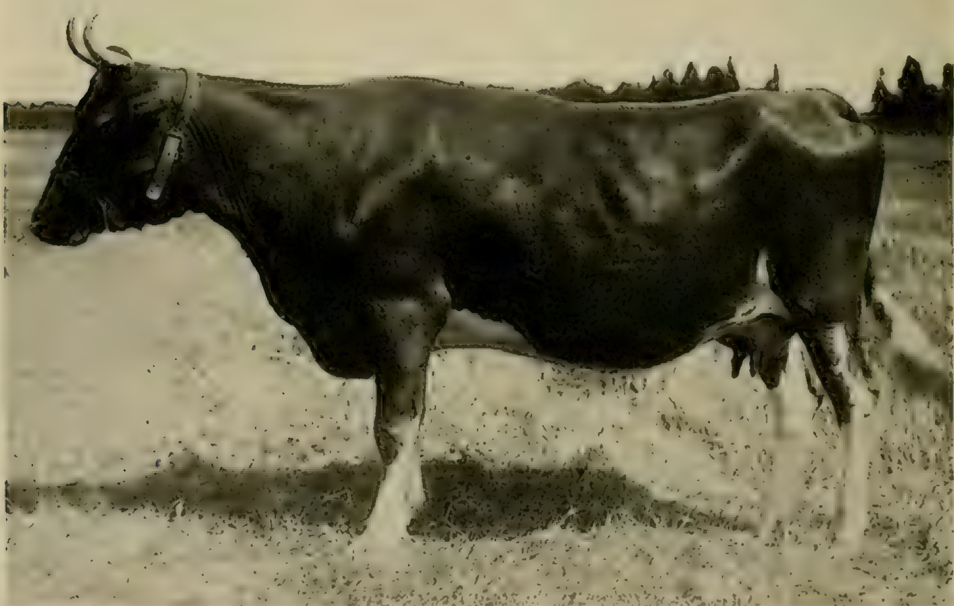
tial milk production of the Jersey sire is given as a dot and dash line (—·—·—). The milk production of the crossbred clearly follows that for the sire's expectation. The milk production of the Holstein-Friesian dam follows a course much higher than does that of the crossbred daughter. The daughter may therefore be said to have only the inheritance of the low milk producing breed. In view of what follows in these curves this result is somewhat surprising. The result cannot, however, be a mistake, because the crossbred daughter's milk production is based on four lactations; the milk production of the Holstein-Friesian dam is based on 11 lactations, and potential milk production of the sire is based on four daughters having two lactations each. These facts make it seem probable that the milk production for the matings are somatically as represented in the top drawing of Figure 14. The photographs of the animals comprising this mating are shown in Figs. 5, 6 and 7.

EIGHT MONTHS LACTATION PERIOD

The duration of milk production for most cows of the leading dairy breeds depends largely on the will of the herdsman as to when the lactation will close. Such being the case it is desirable to have for the whole lactation a time interval over which to compare the milk yield of one cow with that of another. For convenience this time interval has been chosen as eight months. Such a duration of time will allow the inclusion of the records of the Aberdeen Angus cows and their crossbreds where one of the main causes of their low milk yield

HOLSTEIN-FRIESIAN SIRE OF CROSSBRED NO. 12

Taurus Creamelle Hengerveld, whose potential high milk yielding quality was transmitted to the crossbred. (Fig. 8.)



GUERNSEY DAM OF CROSSBRED NO. 12

The eight months' lactation record of this cow, College Gem, was 2673.8 pounds of milk, while that of her daughter, Crossbred No. 12, was 5367.3 pounds. It is thus seen that the crossbred follows more closely the potential high yielding quality of the male parent. (Fig. 9.)

CROSSBRED NO. 12

Offspring of the Holstein-Friesian and Guernsey parents shown on the opposite page. The general conformation of the body shows many points typical of the Guernsey mother; the size of the udder resembles the Holstein-Friesian parent. See the fourth graph in Fig. 14 for comparison of this crossbred's milk yielding quality with that of her parents. While this crossbred's milk record clearly follows the high milking parent, there is a tendency for the crossbred to be intermediate between the two lines. (Fig. 10.)

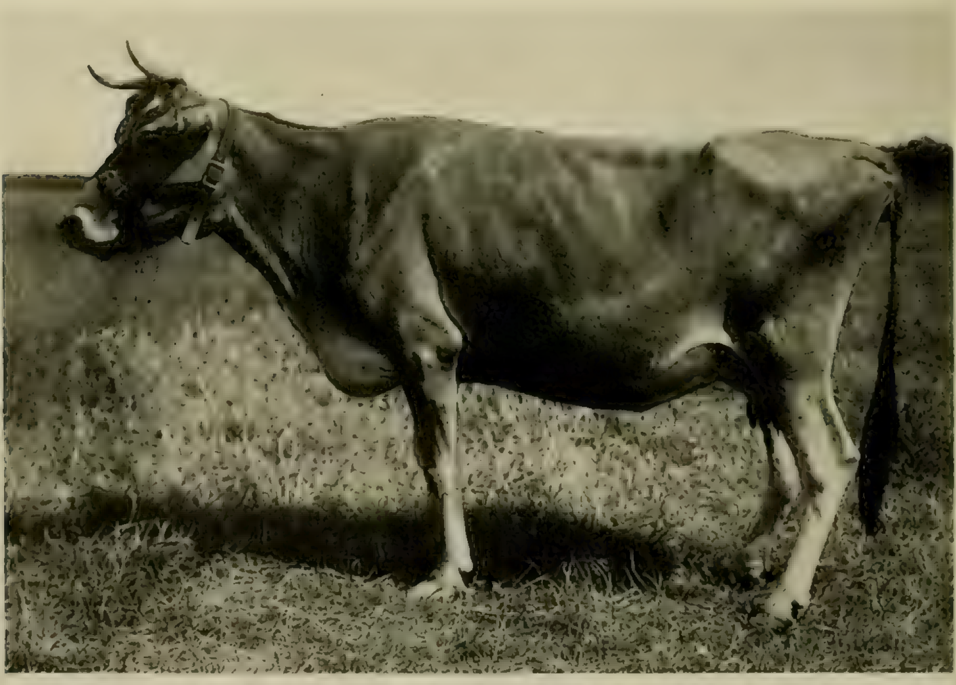
may be duration of lactation as well as the daily quantity of milk yield.

For the eight months lactation period, Crossbred No. 1 produced on the average 4,161.3 pounds of milk. Her dam, Pauline Posch, produced 6026.3 pounds of milk and her sire, Lakeland's Poet's, potential milk yield was 3919.0 pounds. Comparatively speaking, therefore, the crossbred cow was intermediate between the two parents being 1865.0 pounds of milk less than the high line and 242.3 pounds more than the low line. The crossbred was consequently 7.7 times as near the low line of production as she was the high line. If we analyze the graph for her monthly milk yields as shown in Figure 14 it is found that the Crossbred's milk yield follows almost identically that of the low parent, Lakeland's Poet. Only in the tenth month does it show any appreciable deviation from this low production. In this deviation extraneous causes enter, as explained above, in that the lactations are not of equal duration and the record of a cow is determined for whole monthly records only where these are available. This, of course, has the effect of making the end of the lactation record less reliable than its beginning. For the tenth and eleventh month, the record of Crossbred No. 1 resembles the high parent although probably the resemblance is not significant.

The second graph of Figure 14 shows the milk production of Crossbred No. 2 on a monthly basis. The significance of the three different lines is the same as that for the first graph of Fig. 14. Crossbred No. 2's record is unfortunately based on only one lactation record. The record for Canada's Creusa

KAYAN, THE ABERDEEN ANGUS SIRE OF CROSSBRED NO. 16

For an eight months' lactation period, the potential milk yield of this sire was 1661.5 pounds; the production of the dam shown below was 3581.5 pounds, and the crossbred's production was 3264.1 pounds. Thus the crossbred resembles the high producing parent 5.1 times as closely in its milk yield as it does the low producing parent. (Fig. 11.)



COLLEGE RUTH, THE JERSEY DAM OF CROSSBRED NO. 16

As shown by the figures above the high milk yielding quality of this parent was transmitted to the crossbred. (Fig. 12.)

CROSSBRED NO. 16

The product of the Angus and Jersey parents shown on the opposite page. The polled head and heavy fleshing of the fore-quarters are characteristic features of such a cross. For the whole lactation period, this crossbred's milk production was clearly intermediate between that of the high producing parent and the lower producing parent. Compare the records as shown by the last graph in Fig. 14 (Fig. 13.)

is based on six lactation records. The record for the sire, Delva's University De Kol, is that of the Holstein-Friesian milk production for this herd at two years as previously described. The curve for the milk production of Crossbred No. 2 clearly follows that of the Holstein-Friesian, or the high milk producing breed. The continuation of the lactation from the eighth month on for the Crossbred No. 2 would clearly follow the milk yield of the Holstein-Friesian parent. Unfortunately this record is not available as the cow on the tuberculin test showed a temperature, was judged tubercular and killed. Her autopsy did not however show any lesions which were noticeable. Her record is therefore representative, so far as it goes. The photograph of this cow is shown in the following paper of this series, in the next issue of this Journal.

PERIOD OF LOWEST MILK YIELD

Considering the record of the different months individually it is seen that the milk yield of the first four months is more nearly intermediate than is the milk yield of the succeeding months. This more nearly intermediate condition or approach of the crossbred cows to the low line is somewhat typical of the other crosses. What explanation may be found for its occurrence is obscure in the light of our present knowledge. It is known that the time of year when a cow freshens may increase or reduce the milk yield somewhat. The times of year favoring the lowest milk yield are the months July, August, and September in this climate. As Crossbred No. 2 calved in August this may explain her not reaching the production of the high parent during these first four months. Before this

explanation can be finally accepted, however, more work on the relation of the different monthly lactations needs to be done.

The eight months milk production of Crossbred No. 2 was 5337.2 pounds. The milk yield of Canada's Creusa was 3608.5 pounds and that for Delva's University De Kol was 5548.9 pounds. In other words Crossbred No. 2 was within 221.7 pounds of milk of her high producing parent and was 1728.7 pounds of milk more than her low producing parent. The Crossbred No. 2 was, therefore, 7.8 times as close to the high line as she was to the low line. This fact in connection with the milk record of Crossbred No. 1 suggests that segregation of milk producing factors having dominance has taken place in these crosses.

The milk production of Crossbred No. 11, shown as the third graph of Fig. 14, is clearly intermediate between that of her dam Delva Johanna De Kol 146774 and her sire Lakeland's Poet 102603 for the first four months of lactation. From this time on this cow follows closely the milk production of the high milking parent Delva Johanna De Kol. The crossbred record consisted of the average of three corrected records; that of the Holstein-Friesian dam consisted of the average of eight corrected records; that of the sire consists of the average of four pure bred daughters for two lactations each. The photographs of this mating are given in the succeeding paper of this series.

The records of Crossbred No. 11 all commenced in the months of July and August. As previously pointed out the calving in these months is most unfavorable to a high record, so unfavorable as to make a difference of 600 pounds of milk in the eight months milk record of Jersey cows. Whether this explanation will account for the milk yield of Crossbred No. 11 being intermediate between that of the high and low lines during the first four months of lactation is not known; although it is highly probable that the time of calving did have some effect toward reducing the yield. With the dam this time of calving effect on the milk yield of the lactation is approximately averaged as she calved three times in the month of April, twice in the month of March, and once in the months July, June and May. Likewise the record for Lakeland's Poet is approximately averaged although favoring somewhat the high side of the milk production as his daughters calved three times in April, twice in February and once in May, November and January.

The eight months milk yield of Crossbred No. 11 was 4984.8 pounds, that of Delva Johanna De Kol was 5375.8 pounds, and that of Lakeland's Poet was 3919.0 pounds. Crossbred No. 11 w s consequently 391.0 pounds of milk below the milk yield of her high milk line, ancestrally speaking, and 1065.8 pounds of milk above the low milk line. The crossbred cow is consequently 2.7 times as near the high line of milk yield as she is near the low line of milk yield.

The fourth graph of Fig. 14 shows the milk yield of Crossbred No. 12 and her two parents. The photographs of this crossbred and her purebred parents are seen in Figs. 8, 9 and 10. This crossbred's milk record clearly follows the high milking parent throughout most of the course of the lactation. As in the preceding cross there is some slight indication that the crossbred tends to be intermediate between the two lines for the first few months of lactation. Her calving dates were on the whole such as to neutralize any time of year effect on milk yield. Likewise the records of the sire and dam show little of this effect.

The eight months lactation record of Crossbred No. 12 was 5367.3 pounds; the record of her Guernsey dam, College Gem was 2693.5 pounds; the potential record of her Holstein-Friesian sire, Taurus Creamelle Hengerveld, 5548.9. Crossbred No. 12 is consequently 2693.5 pounds of milk more than her Guernsey dam and 181.6 pounds of milk less than her Holstein-Friesian sire or her high parent. The

crossbred's milk yield consequently resembles that of the high line 14.8 times as closely as it does the low line.

The fifth graph in Fig. 14 represents the milk production of Crossbred No. 15 and her parents, Lakeland's Poet, Jersey; and Hearthbloom, Aberdeen Angus. The photographs of the animals composing this mating are shown in the succeeding paper of this series. The graph for Crossbred No. 15's milk production shows the same intermediate yield as is shown in the first few months of lactation by the other preceding crossbreds.

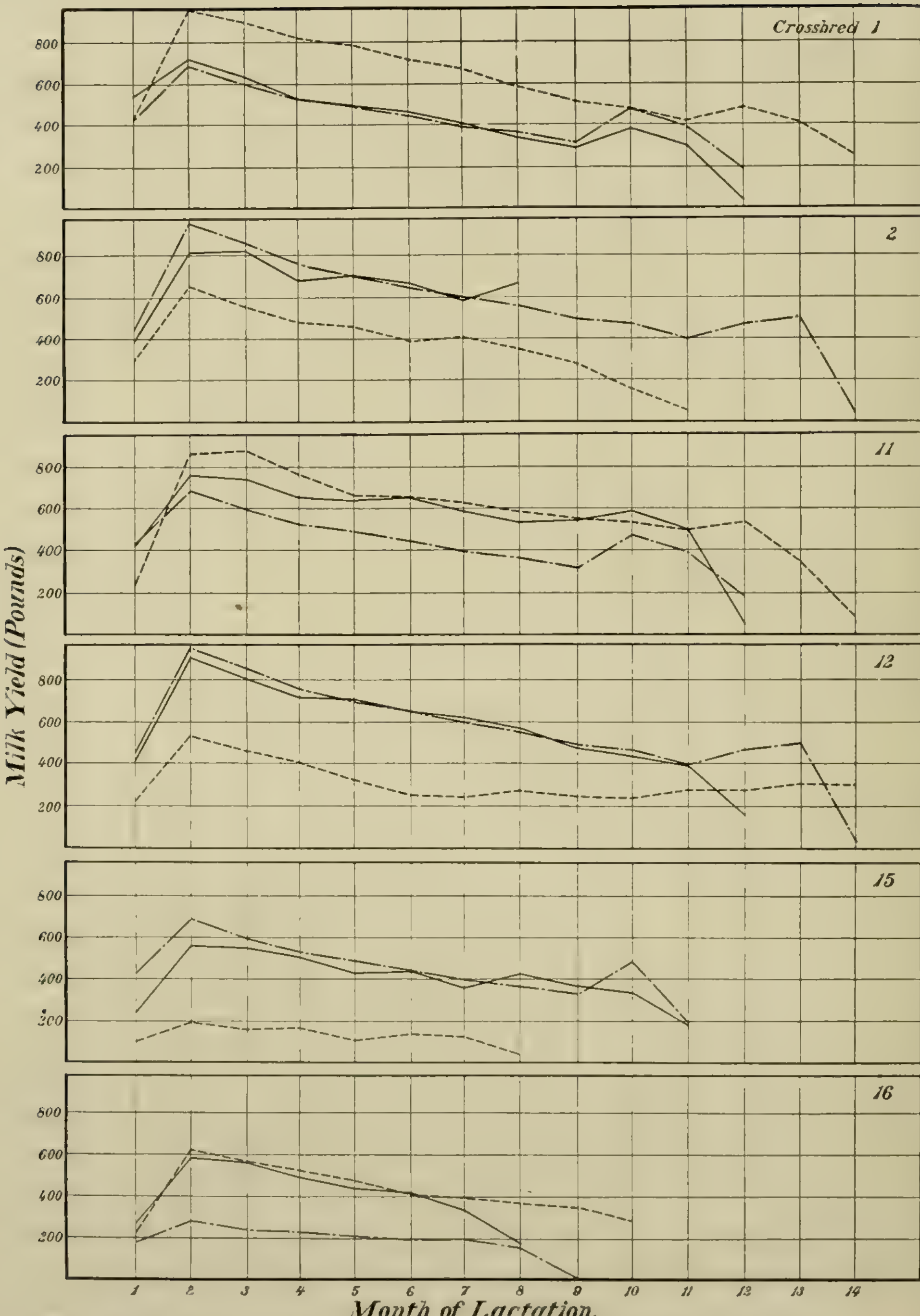
The time of year for the commencement of the lactation has been favorable to a medium to high yield for this crossbred as the months of calving were December (twice) and January (once). The total milk for the eight months period was 3493.0 pounds. The milk yield for the Aberdeen Angus mother was 1065.9 pounds and for the Jersey sire 3919.0 pounds. The crossbred cow was consequently 426.0 pounds of milk less than her high milk producing parent and 2427.1 pounds above her low milk producing parent. From these facts it is seen that this crossbred cow is 5.7 times as near the milk yield of her high milk yielding parent as she is her low yielding parent.

The last graph in Fig. 14 gives the milk yields of Crossbred No. 16, her Jersey dam, College Ruth and her Aberdeen Angus sire, Kayan. The photographs of the animals comprising this mating are shown in Figs. 11, 12 and 13. This cow proved very difficult to settle for her second lactation. She has in fact lost nearly one year due to this cause. The milk production was somewhat higher relatively for the second lactation than for the first lactation, although it did not continue longer in its duration.

The milk production of Crossbred No. 16 is clearly intermediate between that of the high milk producing parent and the lower milk producing parent. The resemblance of the crossbred's milk yield to the high line is very close for the first six months of lactation. From the sixth month to the end of the lactation the crossbred cow declined rapidly in her milk flow.

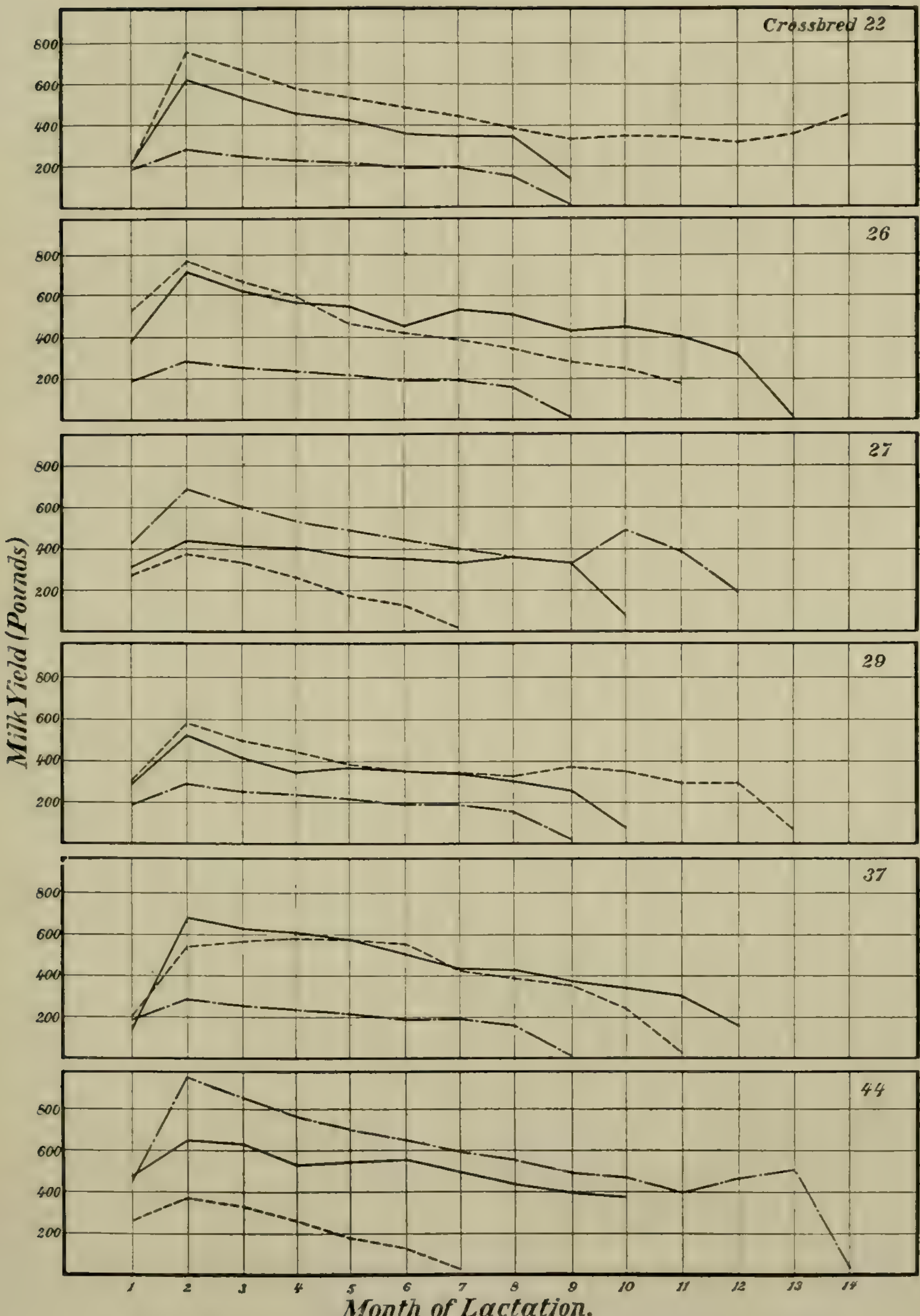
Considering the whole of the eight months lactation Crossbred No. 16 gave 3264.1 pounds of milk. Her pure bred Jersey parent gave 3581.5 pounds for the same period. The potential milk production of the sire was 1661.5 pounds. It is easily seen from the diagram that the duration of the milk flow plays some part in this crossbred's milk yield. Thus up to the seventh month of lactation the crossbred's milk production was 2746.1 pounds as against the milk production of her high producing dam of 2822.7 pounds and of the low producing line of 1312.2 pounds. The difference between the high milk producing line and the crossbred's milk production for the eight months period was 317.4 pounds. The difference of the milk production of the crossbred's milk yield and the low potential milk production of her sire is 1602.6 pounds for the eight months period. The crossbred consequently resembles the high producing parent 5.1 times as closely in its milk yield as it does the low producing parent. If we compare the milk yields for the first six months of lactation we find that the resemblance of the crossbred to the high line milk yields becomes 18.7 times as close as to the low line milk yield.

Fig. 15 represents the milk yield of six of the other later crossbred cows taken in the order of their birth. The milk yield for the first lactation is complete for the first five crossbreds. Four months of the second lactation are available for Crossbred No. 22; six months for Crossbred No. 26; a complete second lactation for Crossbred No. 27; two months for Crossbred No. 29; and three months for Crossbred No. 37. In view of the fact mentioned at the beginning of this paper that the reliability of a cow's record increased as the number of lactations increases, it follows that without doubt the milk records of these crossbreds shown in Fig. 15 will be subject to some modification as the number of lactations increase.



MILK PRODUCTION OF CROSSBRED COWS AND THEIR PARENTS

These graphs represent the milk production, by months and pounds, of crossbred cows Nos. 1 to 16 and their parents. The number of the crossbred is in the upper right hand corner of each set of graphs. The crossbred is represented by the solid line in each case, the dam by the dotted line, and the sire by the dot-and-dash line. (Fig. 14.)



MILK PRODUCTION OF CROSSBRED COWS AND THEIR PARENTS

Showing the records of Crossbreds Nos. 22 to 44. The solid lines represent the crossbreds, the dotted lines for the dams, and the dot-and-dash lines for the sires. (Fig. 15.)

Crossbred No. 22 was the result of the mating of Kayan, Aberdeen Angus bull, to College Creusa, Guernsey cow. The corrected monthly milk yield for the sire, dam and resulting crossbred is shown in the first graph of Fig. 15. The milk record of this crossbred cow has had some difficulties. In her second lactation this cow gave birth to a calf at 245 days which did not live. At that time her udder had only just begun to make up to its coming lactation. Consequently Crossbred No. 22 produced no milk for this lactation. The lactations which have been perfectly normal and which are used to determine her milk production are those commencing at two years and three months and at three years and ten months. The abortion which came in between these dates is thought to have come from an accident in the yard during the time the cows were out for exercise and not from contagious abortion of cattle. This supposition is made somewhat stronger by the fact that only rare cases of this kind have appeared in the herd and then were some time apart.

From the upper graph of Fig. 15 it is clearly seen that the milk yield of Crossbred No. 22 is intermediate between that of her high and her low producing line ancestrally speaking. The lactation for each month is however nearer the milk yield of the high parent than it is near the low parent. Thus during the first eight months, the milk yield of Crossbred No. 22 was 3320.8 pounds, her high producing dam, College Creusa produced 4057.9 pounds and her low producing sire, Kayan's, potential production was 1661.5 pounds. Crossbred No. 22 was consequently 737.1 pounds of milk less than her high producing parent and 1659.3 pounds more in milk yield than her low producing parent or Crossbred No. 22 favored the milk yield of the high line 2.3 times as closely as she did the milk yield of the low line.

The record for Crossbred No. 26 together with that of her parent is shown in the second graph of Fig. 15. The mating which produced this cow was Kayan, Aberdeen Angus bull, bred to Creusa of Orono 3d, Guernsey cow. The milk yield of this crossbred cow is intermediate between that of her high and low parents for the first four months of lactation. After the fourth month the milk yield of the high parent is surpassed by that of the crossbred. As will be noted from the other preceding graphs this is the first instance where the crossbred has actually surpassed the milk yield of her two parents. The milk yield of Crossbred No. 26 for the eight months period is 4303.5 pounds, that for Creusa of Orono 3d is 4156.1 pounds and for Kayan 1661.5 pounds. The crossbred cow produced 147.4 pounds more milk than her purebred Guernsey parent and 2642.0 pounds more than her sire's potential milk yield. Crossbred No. 26 consequently resembles the high line of production 17.9 times as closely as she does the low line of production. Crossbred No. 26 produced this amount of milk when calving at one of the most unfavorable times of the year, September, whereas the lactation of her parents came in months which were favorable to an average yield.

Crossbred No. 27 was the result of a mating of the Jersey bull, Lakeland's Poet, to the Aberdeen Angus cow, Orono Madge. The milk yield of Crossbred No. 27 is shown in the third graph of Fig. 15. For the first four months of lactation the milk production of this cow is lower than that of the intermediate between the high and the low milk producing lines of her ancestry. From the fourth month of lactation this crossbred's milk production continues to constantly approach the milk production of her high line ancestry. In describing the milk production of this cow it might be said it was the persistence with which this cow maintained her milk production month after month rather than the large quantity of her milk yield at any one time that causes her to be intermediate between the high and low lines of production. In this connection it should be said that this crossbred cow commenced her lactations in two

months quite unfavorable to a high milk flow for the subsequent eight months of production.

The milk yield for the eight months period was 2995.7 pounds for Crossbred No. 27; 3919.0 pounds for Lakeland's Poet, her purebred Jersey sire; and 1569.3 pounds for Orono Madge, her purebred Aberdeen Angus dam. The crossbred cow's milk production was consequently 923.3 pounds less than her high producing sire and 1426.4 pounds more than her low producing dam. The crossbred cow resembled the high producing parent 1.5 times as closely for the eight months period as she did her low producing dam.

The fourth graph of Fig.15 shows the monthly milk yield of Crossbred No. 29 and her purebred parents. Crossbred No. 29 is the result of a cross between the Aberdeen Angus bull, Kayan, and the Guernsey cow, Creusa's Lady. The milk yield of the crossbred cow is intermediate between that of her high milk producing parent and her low milk producing parent for the first four months of lactation. After the fourth month Crossbred No. 29 follows the high line of production quite closely until the last two months of her lactation when she approaches the intermediate again.

For the eight months lactation period Crossbred No. 29 produced 2909.7 pounds of milk; her purebred Guernsey parent produced 3271.5 pounds and her Aberdeen Angus sire s potential milk yield was 1661.5 pounds. The difference of the crossbred's milk yield and that of her Guernsey mother was 361.8 pounds. The difference from the potential milk yield of her sire was 1248.2 pounds. The crossbred cow consequently resembled her high producing line 3.4 times as closely as she did her low producing line.

Crossbred No. 37 was the result of mating Kayan, Aberdeen Angus, to Dot Alaska, Ayrshire. The milk production of this crossbred exceeded that of her high line Ayrshire dam during the first four months of lactation. After that time the milk yield was approximately equal. During the first eight months of lactation Crossbred No. 37 produced 3984.7 pounds of milk or 129.0 pounds more than the production of her purebred Ayrshire dam. The potential milk production of Kayan was 1661.5, pounds, or Crossbred No. 37, his offspring, produced 2323.2 pounds more milk than this potential yield. The crossbred cow was consequently 18 times as close to the high line of production as she was to the low line of production. The time of calving during the year was favorable to medium to high yield records.

Crossbred No. 44 was the result of crossing the Holstein-Friesian bull, Taurus Creamelle Hengerveld on to the Aberdeen Angus cow, Orono Madge. The bottom graph of Fig. 15 shows the milk production of the two parents and the crossbred. Too much weight should not be given this record as the first lactation record is as yet not even complete. It is to be expected that subsequent lactation records may modify considerably the record of this crossbred cow from what it is as it now stands. For the first four months of lactation the crossbred cow occupies a strictly intermediate position between the high and low lines of production. After the fourth month the lactation record approaches the high line of production. The milk yield for the eight months period was 4306.3 pounds for Crossbred No. 44; 5548.9 pounds for the potential milk yield of the pure bred Holstein-Friesian sire; and 1569.3 pounds for the Aberdeen Angus dam. The crossbred cow was 2737.0 pounds more milk than its low producing dam and 1242.6 pounds less than its high line sire. The crossbred resembles the high line of production 2.2 times as closely as it does the low line of production.

DOMINANCE OF MILK PRODUCING FACTORS

If the substance of the preceding pages is recapitulated it is found that Crossbred No. 1 resembles her low producing parent 7.7 times as closely as she does the high producing parent. The other eleven crossbreds resemble

the high producing line of milk production from 1.5 to 18.0 times as closely as they do the low line of milk production. If this paralleling of the high line production is averaged, it is found that the crossbreds resemble the high line of production 4.76 times as closely as they do the low line. These facts argue for the transmission of milk production by factors which show partial dominance. It would not seem that they argued for increased vigor of heterosis only because of the case of Crossbred No. 1, where the low line milk yield was definitely transmitted instead of the high yield. In fact it would appear that this crossbred is more likely to be a segregate of low milking factors from the high milking factors carried by her dam.

Three levels of milk production are crossed in these experiments. The Aberdeen Angus cattle constitute the lowest level, the Jersey, Guernsey and Ayrshire cattle averaging about the same in milk yield constitute the intermediate level of production and the Holstein-Friesian cattle having the highest yield represent the highest level of production. It is of some interest to compare the results of crossing the different levels. If we omit the result of Crossbred No. 1 it is found that the Holstein-Friesian cows or bulls mated to the second group of cows or bulls (Jersey, Guernsey, or Ayrshire) produced three offspring who are 8.43 times as near the milk production of the high level on the average as they were the low line of production.

The only cross involving the Holstein-Friesian and Aberdeen Angus, Crossbred No. 44, was 2.2 times as close to the high line of production as she was close to the low line of her parent's milk yield.

It is of interest to note in this connection that Crossbred No. 44's milk yield resembles closely the milk yield of the intermediate group (Jersey, Guernsey and Ayrshire) of these experiments.

The crosses involving the second level of milk production (Jersey, Guernsey and Ayrshire) mated to the third group Aberdeen Angus, had crossbred offspring resembling the high line 7.7 times as closely as they did the low line of production. This figure compares favorably with that of the Holstein-Friesian x Jersey crosses.

If the crosses are compared to determine what effect the high line on the sire's side of the cross may have in comparison with the effect produced by the high line being on the dam's side of the cross it is found that the results in the three lines are contradictory. When the Holstein-Friesian sires were mated to second class dams, Guernseys, the offspring resembled the high line 11.3 times as closely as she did the low line. When the Jersey sire, second class, was mated to the Holstein-Friesian cows, highest class, the milk production once resembled the high class 2.7 to 1, and once the low line 7.7 to 1. The crosses involving the highest milk line, Holstein-Friesian bull, to the lowest milking line Aberdeen Angus cow produced an offspring resembling the high line 2.2 times as closely as the low line. The crosses of the second level in milk production to the third level show that when the higher level is on the sire's side the daughters resembled the high line 3.6 times as closely as they do the low line. When the higher level is on the dam's side the daughters resembled the high line 9.34 times as closely as they did the low line. It seems doubtful from these results if there are modifying sex linked factors present.

MENDELIAN TRANSMISSION OF MILK YIELD

The literature on this subject is surprisingly meag r considering the economic importance of milk and its products. Of those studies which are available that made by Wilson[5] is one of the earliest. This paper is devoted to showing that with such a breed as the red Dannish there may be wide

[5] Wilson, James. 1911. The Inheritance of Milk Yield in Cattle. In Sci. Proc. Roy. Dublin Soc. Vol. 13, pp. 89–112.

difference between the milk yield of the daughter and the dam,—that is these differences do not always blend gradually, in fact as a rule they progress by wide steps. Further it is attempted to show that the sires in the red Dannish breed appear to be differentiated into those whose daughters are all low producers; those whose daughters may be low producers, medium producers, and high producers; and thirdly those whose daughters are all high producers. The data to support these conclusions are admittedly fragmentary and open to several criticisms. It is however held to show that milk yield is transmitted in mendelian fashion with the heterozygote intermediate between the pure forms.

The manner of grouping the data and its correction for age, etc., would seem to more or less force this conclusion. It does therefore offer no further critical information to differentiate between the transmission of milk yield by factors showing partial dominance as was apparently the case in our experiment and any other hypothesis.

Two practical experiments carried on by breeders in England are of particular interest as their crosses parallel some of those in these experiments. The object of the experiments was to cross the Jersey with the Aberdeen-Angus and to fix in the resulting offspring the hardiness of the Angus with the milk yield of the Jersey. The original crosses were made Aberdeen-Angus bull to Jersey cows. Although records were kept, no figures are cited in the paper[6] on this herd. The qualitative statement is, however, made that the F_1 cows show a high yield of milk, ranking almost as high as their Jersey dams.

In another section of England a similar cross was made by another breeder with the same objects in view. This breeder, Mr. Stevens,[7] makes a similar statement in regard to the milk yield of the F_1 cows.

Kildee and McCandlish,[8] record a similar experiment which incidentally furnishes some data on the transmission of milk yield. They crossed scrub cattle whose milk yield averaged between 3300 and 3900 pounds to Holstein-Friesian sires. The resulting F_1 offspring averaged 5561.6 pounds of milk. Crosses to Guernsey and to Jersey bulls did not increase the F_1 average production over that of the scrubs, although one daughter of a Guernsey sire did nearly double her milk yield over that of her dam. No age correction was applied to these records. The length of lactation was also not strictly comparable between animals. Several bulls of each breed were used. Despite these handicaps the results indicate that there was a partial dominance for milk yield expressed in the F_1 offspring of the Holstein-Friesian sires. The case of the single exceptional offspring of one of the Guernsey sires can likewise be explained on this basis for it has been shown that within a breed wide differences between sires in their ability to transmit milk yield may occur.[9] Such differences of course argue for differences in the factors for transmitting milk yield within the breeds similar to those illustrated in the experiments previously described.

Another extensive experiment was begun for similar practical objects by

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[6] Parlour, W. Jersey-Angus Cattle. In Live Stock Jour. (London) 77 (1913) No. 2025, p. 85. Kuhlman, A. H. Jersey-Angus Cattle. In Jour. Heredity 5 (1915) No. 2, pp. 68–72.

[7] Stevens, H. D. E. Jersey-Angus Cattle. In Live Stock Jour. (London) 77 (1913) No. 2025, p. 132.

[8] Kildee, H. H. and McCandlish, A. C. 1916. Influence of Environment and Breeding in Increasing Dairy Production. Bul. 165. Iowa Agricultural Experiment Station, pp. 383–402.

[9] Pearl, Raymond, Gowen, John W., and Miner, John Rice. 1919. Studies in Milk Secretion. VII. Transmitting Qualities of Jersey Sires for Milk Yield, Butter-Fat Percentage and Butter-Fat. Maine Agricultural Experiment Station. Annual Report for 1919, pp. 89–205.
Gowen, John W. 1919. Report of Progress on Animal Husbandry Investigations in 1919. Maine Agricultural Experiment Station. Annual Report for 1919, pp. 249–284.

Mr. Bowlker on the crossing of the Guernsey and Holstein-Friesian breeds of cattle. The results as analyzed by Castle[10] show that the milk yield for 31 F_1 heifers resembled that of the Holstein-Friesian parents 1.88 times as closely as it did the Guernsey parents in the first lactation. In the second lactation the resemblance of the milk yield of the F_1 crossbreds was 3.78 times as close to the Holstein-Friesian parents as it was to the Guernsey parents. Unfortunately these records are subject to some criticism perhaps the most serious of which is the fact that all records of a given group, parents or crossbreds, are lumped together and the average used instead of being subject to individual analysis. Such a lumping together would hide such results as that of the mating for Crossbred No. 1. Another criticism of more or less serious nature comes in the throwing together of milk records of animals of quite different ages without applying age corrections. Considering these disturbing features the results are on the whole quite similar to those presented in this paper.

In the light of these all too meager data the results of this paper would seem to be supported by those of the other investigations on this subject. Such being the case the conclusion seems sound that the inheritance of milk yield appears to show a partial dominance of the high milk yield to the low milk yield.

[10] Castle, W. E. 1919. Inheritance of Quantity and Quality of Milk Production in Dairy Cattle. In Proc. Nat. Acad., Vol. 5, pp. 428–434.

OUR MOST SIGNIFICANT CROPS—OUR BOYS AND GIRLS

"War throws a spotlight of convincing clearness upon national defects. . . . We are beginning to suspect, if not to fully realize, that even more essential and fundamental to the integrity and permanency of a nation than scientific progress, political achievement, industrial development and economic accomplishment, are biologic soundness and fitness, the health of the people.

"This national asset, health, while the most essential, is at the present time the most endangered of all our natural resources.

"Shall we not provide as thorough and effective health care and physical education for the children of our country as we furnish for the young men in the army and navy?"

"What about the basic needs of the great draft army of the nation's children who must supply the human units of the citizenry of the next generation; who must bear the burden of civilization in peace and in war? What shall we do about the neglect of the children who hold the future of civilization in their immature lives?"

"The children of our country deserve as effective physical care as the livestock.

"The children are entitled, even in war times, to as careful attention and cultivation as the crops."

"Shall not the children, drafted by compulsory education into our schools, be assured of as skillful and satisfactory care as the soldiers in camp?"

"I wish you appreciated the children and youth of this republic. They make up, in possibilities, the finest generation of human beings the world has ever seen. They make you feel that even more than the great museums and monuments, more than great industrial plants and ships, more than great skyscrapers and cathedrals, they should be guarded and protected, cultivated and developed for America—for the World."—*From an address by Thomas D. Wood, M.D., Columbia University, New York.*

HERITABLE CHARACTERS OF MAIZE

V. ADHERENCE

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ADHERENCE is a variation in which the leaves, bracts and inflorescences coalesce. Any or all of these organs may adhere to one another to a varying extent. In extreme cases the upper leaves and terminal inflorescences are so firmly compacted into a hardened mass that the parts can not be separated. In less extreme cases the adhering organs separate naturally with the pressure of the growing parts. Frequently the leaves and even husks adhere so firmly to other organs that they are ruptured by the force of the elongating plant or shoot and such plants have a characteristic ragged appearance.

In some cases the variation is exhibited in seedlings but unless the leaves of the young plants adhere so firmly as to prevent further growth, the plants recover and apparently grow normally until the ear bearing node is reached, at which stage their adherent nature is manifested again. (See Fig. 16.)

The firm union of the upper leaves prevents proper elongation, causing startling contortions of the confined culms. (See Fig. 18.) When the ear is included in the adhering mass the enclosing husks also are united and unless they are opened artificially the silks cannot be exserted.

In many cases the growing ear, held firmly at the upper end, is forced into contortions similar to those of the culm. (See Fig. 19.) This purely mechanical inhibition of elongation reduces the length of the affected internodes as well as the ear and where the variation is pronounced, seed rarely is obtained. The tassels of such plants are greatly altered, being compressed into a solid structure, never expanding into the familiar branched panicle. In such an adherent inflorescence pollen is shed only from the spikelets of the lower or outer branches and not even from these unless the inflorescence has been artificially liberated from the confining mass of sheaths and blades. In less extreme cases the tip of the central spike will be exserted naturally, producing a small quantity of pollen and it is from such plants as these that the variation is propagated most readily.

The glumes of the staminate spikelets often are reduced greatly in length and altered in appearance resembling the hardened glumes of the ear. Not infrequently they have been so reduced in length that the anthers protrude from the unopened spikelets. The firmly compacted male inflorescence with the altered glumes strongly suggests the cob of ear, but when such an inflorescence is sectioned there is no evidence of fasciation and the interior branches and central spike are found to have developed spikelets.

BREEDING MUST ELIMINATE ADHERENT PLANTS

The undesirability and entire worthlessness of adherent plants needs no emphasis and the variation takes its place with the ever increasing list of detrimental recessive abnormalities which breeding must eliminate.

The adherent variation was found in the second generation of a hybrid between the Boone County white variety and brachytic.[1] Two plants of a brachytic progeny were crossed with two plants of an inbred strain of Boone. In each cross brachytic plants were used as the female parents. The plants of the first generations were all normal and of greatly increased vigor.

Several self-pollinated ears were obtained from both hybrids but only three

[1] Kempton, J. H. A Brachytic Variation in Maize. U. S. Dept. of Agr. Bull. 925. Feb. 1921.

THREE MAIZE SEEDLINGS SHOWING THE ADHERING EARLY LEAVES

Adherence is an inherited variation in which the leaves, bracts and inflorescences unite or grow together. Any or all of these organs may adhere to one another to a varying extent. In some cases the variation is exhibited in seedlings. The mortality of such seedlings usually is high. Photograph natural size. (Fig. 16.)

TWO ADHERENT BRACHYTIC PLANTS

These plants produced no seed and the tassel branches unlike those of non-adherent sister plants are compacted into a hardened mass. (Fig. 17.)

progenies were grown the following season. These three progenies segregated in the expected manner, having approximately three normal plants to one brachytic but two of the progenies in addition produced plants with adherent organs. These two progenies were descended from the same first generation hybrid between brachytic and Boone. The adherent variation was not noticed until the plants had practically completed their growth at which time it was a striking abnormality. It was immediately apparent that there were no plants in which the brachytic character of the culm was combined with the adherent organs, all the adherent plants being found in the group of normal stature. The classification of the plants is given in Table I.

The percentage of adherent plants for the combined progenies, including normal and brachytic plants, is below that expected for a simple Mendelian character. This deficiency is probably due to the death rate in the seedling stages of the most extreme adherent plants. Since the variation was not found until the plants had reached maturity the counts were based on the survivors of the season. Subsequent generations have shown that the character appears in the seedling stage and that many of the badly affected plants die after the production of 3 or 4 leaves. The absence of brachytic adherent plants indicated a high linkage between normal stature and adherent but this hypothesis has not been sustained by the progenies.

Extreme cases of adherence are impossible to propagate and the progenies, especially those grown from self-pollinated seed, were from plants that expressed the character in an intermediate form. Difficulties also are encountered in satisfactorily bagging the

AN ADHERENT PLANT PARTLY DISSECTED

Showing the base of the compact tassel and the contorted stalk. The ear of this plant was not confined in the coalesced sheaths but the husks were firmly united and the prophyllum, fastened to the outer husks, has pulled apart as the ear lengthened. Photograph natural size. (Fig. 18.)

ears which, as the illustrations show, are often greatly twisted. This fact must be borne in mind in considering the results obtained with the progeny of adherent plants. The classification of the plants of the progenies of the adherent variation is shown in Table II.

Three progenies were grown from self-pollinated adherent plants, and two of them produced six apparently normal plants in a population of 68, the others being adherent. These may have resulted from faulty technique in pollinating or perhaps a failure to develop the character to a noticeable degree. This latter hypothesis would seem the more plausible in view of the large number of normal plants produced by crosses between adherent plants, and the fact that the normal plants were no more vigorous than their adherent sisters. Self-pollinated ears have been obtained from these normal individuals, and they will be tested next season.

ADHERENCE NOT LINKED WITH NORMAL STATURE

Of the progenies grown from self-pollinated adherent plants, two produced adherent plants of brachytic stature, disposing of the hypothesis that normal stature is closely linked with the adherent variation. (See Fig. 17.) Eight brachytic plants produced by the progenies in which the adherent variation was found were self-pollinated. These eight plants were normal with respect to the adherent character but progenies of two of them segregated into normal, and adherent. The percentage of adherent plants in these two brachytic progenies is surprisingly large for a simple Mendelian character, but the populations were so small that the deviations may be due to chance. Plants combining the brachytic and adherent variations are extremely hard to propagate and no self-pollinated seed was obtained from them.

PARTLY DISSECTED ADHERENT PLANT OF NORMAL STATURE

Showing the twisted ear and the coalesced upper sheaths. Photograph natural size. (Fig. 19)

A normal brachytic plant was crossed with an adherent plant of normal stature and the first generation segregated into equal number of brachytic and normal plants indicating that the adherent parent was heterozygous for brachysm, affording additional evidence that adherence is not linked with normal stature.

Considering the possibilities for variability in expression and the difficulty of propagating extreme plants it would seem not unreasonable to assume that adherence is a simple Mendelian character recessive to the normal condition and its linkage relations to the other variations should be studied. Owing to the difficulty in obtaining seed only very small quantities can be furnished interested investigators.

TABLE I — CLASSIFICATION OF THE PLANTS OF THE SECOND GENERATION OF THE BRACHYTIC-BOONE HYBRID WHICH PRODUCED ADHERENT PLANTS

Progeny Designation	Normal Stature		Brachytic Stature		Adherent % in entire progeny	% Adherent in plants of normal stature
	Normal	Adherent	Normal	Adherent		
Dh436W1L19......	66	17	18	0	16.8±2.49	20.5±2.98
Dh436W2L19......	58	22	24	0	21.2±2.71	27.5±3.35
Total...........	124	39	42	0	19.0±1.85	23.9±2.25

TABLE II—*Classification of the Plants of the Progenies of the Adherent Variation*
(N=Normal; A=Adherent)

PROGENY DESIGNATION	Seedlings		MATURE PLANTS				Percent Adherent Seedlings	Percent Adherent Mature Plants	Percent Brachytic
			Normal Stature		Brachytic Stature				
	N	A	N	A	N	A			
Adherent Self-Pol...........	27	10	0	22	0	8	27.0±4.9	100.0	26.7±5.4
" "	74	41	2	34	0	0	35.6±3.0	94.4±2.6	0.0
" "	44	18	3	23	1	5	29.0±3.9	87.5±3.5	18.8±4.7
Adherent x Adherent.......	25	32	4	28	0	0	56.2±4.4	87.5±3.9	0.0
" "	114	34	12	12	7	3	23.0±2.3	44.1±5.7	29.4±5.3
Brachytic Self-Pol.	53	13			13	9	19.7±3.3	40.9±7.1	100.0
" "					19	17		47.2±5.6	100.0
Six sister brachytic progenies self-pol...................					180			0.0	100.0
Brachytic x Adherent F_1.....			12		12			0.0	52.2±7.0

THE IMMIGRATION PROBLEM TODAY

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WE ARE facing the most serious crisis which has ever arisen in the history of immigration to the United States. The facts in the present situation should be widely known. Without an intelligent understanding of the problem, no sound and constructive immigration legislation can be framed. The essential facts are as follows. They are not exaggerated, and are all based on authoritative sources of information.

First: The Rising Tide of Immigration

As was to be expected, immigration has shown a tremendous increase during the past few months. Since July 1, 1920, the alien arrivals at the port of New York alone have averaged about 3000 a day. During the present calendar year the total has come close to 1,000,000, approximating pre-war figures. And, as Commissioner F. A. Wallis, New York, has put it, "All records are going to be shattered from January on." "Whole races of Europe are preparing to remove to the United States. Never since the early days of barbarian Europe has there been such a wholesale migration of population as that which is now in contemplation, with the United States as the destination." Considerably more than 1,000,000 aliens will come in 1921 unless we erect a barrier to cut down their numbers. On Nov. 15 last, more than 16,600 aliens were either at Ellis Island, or on ships in New York harbor awaiting inspection. On Dec. 19, 12,000 came in on eight steamships. These are not unique cases. Incoming steamers are crowded to their utmost capacity. A group of steamship agents not long ago told Commissioner Wallis that immigration to the United States had barely started; that 15,000,000 men, women and children, representing every nationality in Europe, are "fighting for passage to the United States." These estimates take no account of the German immigration which, in the opinion of every competent authority, will start to come here as soon as the existing technical state of war is terminated. This German immigration is estimated at from 2,000,000 to 10,000,000, with the balance of probability in favor of the larger figures. Surgeon-General H. S. Cumming, of the U. S. Public Health Service, has expressed it as his view that at least 7,000,000 people are trying to get here from European and Asiatic countries where serious epidemic diseases are rampant. In the opinion of Commissioner Wallis, as stated before the Senate Immigration Committee on Jan. 5, 1921, Eastern Europe "is in the grip of four epidemics—typhus, typhoid, dysentery and tuberculosis." The war has undermined the health of the natives of those countries, and such immigrants are "dangerous to the public health of the United States."

Such a situation has never before confronted us. This is not "normal" immigration. It is a frenzy, a panic, a stampede, a mob, without calculation, without sound judgment; a seething mass of humanity with but one idea—America.

Second: The Undesirable Character of the Impending Immigration

The most recent, unprejudiced and authoritative reports on the general conditions of the aliens who are planning to come to this country are those received by the Consular Service of the Department of State, from officers of this Government who have personally visited the various countries abroad.

This evidence is embodied, in a condensed form, in Report No. 1109, 66th Congress, 3rd Session (Dec. 6, 1920), submitted from the Committee on Immigration and Naturalization, to accompany House Bill No. 14461. It is clear that a majority of these prospective immigrants are "physically deficient"; "mentally deficient"; "economically undesirable"; "socially undesirable"; of low standards of living, "not of the most desirable class."

In the light of these reports by United States Consular Officers, the House Immigration Committee is certainly stating the case very mildly when it says in its own report: "The Committee is confirmed in the belief that the major portion of recent arrivals come without funds. It was apparent to the Committee that a large percentage of those arriving were incapable of earning a livelihood. . . . . A study of the new immigration from Central Europe convinced many members of the Immigration Committee that the arriving immigrants are not those who might go to farms; that they are not agriculturists, but mainly additional population for our principal coastal cities and congested industrial districts."

On this same point, the following statement from a foreign correspondent of the Philadelphia *Public Ledger*, in a cablegram dated Warsaw, Dec. 11, 1920, may be quoted:

"The most extraordinary, hopeless, destitute and pathetic emigration which the world has known now is making its way to America, the promised land, through Poland from as far east as Kief, and from the Russian territory north and east of the Black Sea. Even from Georgia, masses of poor, disease-laden people are making their way to America.

"Within three weeks, 150,000 have reached the Warsaw territory. This is only a beginning. Unfortunately, Bolshevist agitators and Communists are with the majority of the hordes and are confident that in the general confusion they will be able to get into America, where they propose to spread propaganda.

"American citizens in Warsaw are distressed and alarmed over the character of the immigration. . . .

"The Warsaw government has protested to the American consulate that the gathering of people in Warsaw is creating a dangerous health condition, asking that steps be taken to correct the conditions. The American officials have no power to check the Russian flood to Poland."

A recent writer has said: "Ignorant of our language, of our laws and institutions, of our industrial and agricultural methods, what would this seething mass of wretchedness do if dumped on our shores? What but add to its woes and our own? How could we make room for it? How educate it? How fit it for any part in our scheme?"

Third: The Impossibility of Adequate Inspection

At best, during slack immigration, our inspection of incoming aliens is none too effective. Now, with the flood of immigration, medical and general inspection is hopelessly inadequate. Our laws for the exclusion of insane, idiotic, imbecile, feeble-minded and diseased immigrants are excellent, *on paper*. But when aliens file past the inspectors with more or less of the speed at which a line of people at a railroad station files by a ticket-window it is clear that most cases of mental and many of physical deficiency get by. The need of more "hands" to do our labor is constantly being urged. "Hands across the sea" are the cheapest, so we import them. Let us not forget that we are importing not "hands" alone but bodies and hereditary tendencies also. It is of vital consequence that the quality of these human beings who come to us from other lands should be of the best, so that they shall not injure but shall improve our stock. Every day that passes witnesses the landing on our shores of many aliens whose coming here is absolutely certain to result in a deterioration of the

mental and physical standards of the American race of the future. This is not a chance sensational statement. It is the conviction of competent medical authorities who know the present conditions of immigration, and the wholly perfunctory and inadequate medical inspection which passes the aliens without proper examination as to their physical and mental condition.

Fourth: A Period of Unemployment Has Begun, and Immigration is Not Needed to Supply Labor

The enormous industrial demands during the war, and the later expansion of our export trade, naturally resulted in a great influx of workers from the country districts into the cities, and of a very considerable abandonment of domestic service for the better paid positions in industry. This change in the conditions of employment brought about a shortage of farm labor and also a shortage of domestic servants. But the tide has turned. There is a general slackening of industrial activity. Mills and shops are slowing down or closing. In many cases employees have been willing to accept a reduction in wages rather than have their jobs cease altogether for a time. We are facing a period of general unemployment. Already a flow of labor from the cities to the country is reported to be setting in, and farm labor will again be supplied by men who left the farms for the mills and machine shops. On the other hand, also, thousands of women who left domestic service for industrial work will soon be ready to go back to their old jobs, and at lower wages than they have been receiving in industry. In other words, the crisis in the labor situation has passed. Unemployment will increase. A wholesale immigration is not needed, and will greatly aggravate the approaching economic situation.

There is surely something radically wrong in the following situation: Hundreds of thousands of men and women already in the United States are out of work, and their number is increasing daily. Congress and State and municipal authorities are being urged to provide work and support for these people at public expense. Yet every week there are being landed at our ports thousands of aliens, the large majority of whom are very close to the pauper line, and all of whom must, in some way or other, be provided with work, or else be supported by public or private funds. Where is the logic, or the justice, in such a condition of things? Canada, which handles its problem of alien immigration far more effectively and far more intelligently than we handle ours, has recently increased the individual financial entrance requirement to $250 in order to improve the condition of unemployment now prevailing in the Dominion.[1]

Fifth: Present and Impending Immigration Will Not Furnish the Kind of Labor Needed on Farms

This point has already been emphasized in the Consular Reports and in the Report of the House Immigration Committee above referred to. Only 2.8% of the immigrants of the past year purported to be "farmer." Our past experience has shown that immigrants inevitably flock to centers where their compatriots are already congregated. This is happening now. The large majority of incoming aliens are going to our great cities, and to the congested districts. Delegations of representative citizens from certain Western cities have recently been to

[1] "Paragraphs 1 to 3 of the former Order-in-Council, applicable to mechanics, artisans and laborers, have been suspended, and four others substituted, by which "no immigrant of the mechanic, artisan or laborer classes, whether skilled or unskilled, shall be allowed to land in Canada unless he possesses in his own right money to the amount of $250, and in addition transportation to his destination in Canada. If an immigrant in the classes mentioned is accompanied by his family, he must possess in addition to transportation for his family to their destination, a further sum of $125 for every member eighteen years old or over and $50 for each child to five years old and under eighteen years."

Ellis Island, to urge upon the Commissioner of Immigration there the importance of sending the new arrivals to the farming districts, in order that the cities from which these delegations came may not be further burdened with great numbers of new immigrants. The Federal authorities are said to be doing what they can to "distribute" as many aliens as possible. But, as President Roosevelt well said in one of his messages to Congress, "distribution is a palliative, not a cure." Even if many thousands of aliens were actually "distributed" where there is a lack of farm laborers, the majority of them would not be effective. What our great farming districts need is highly intelligent labor. They want men who are skilled in American farming methods. They want men who can manage modern agricultural machinery. They do not want ignorant, unskilled, non-English-speaking foreigners, who know little beyond the use of a primitive kind of hoe. The writer has talked with many men who own large farms in the Middle West, and he has found them of one mind on this matter.

It is highly significant that at the 40th Annual Session of the Farmers' National Congress, held at Columbus, Ohio, with delegates from over 30 States in attendance, the following resolution was unanimously adopted (Nov. 19, 1920): "Resolved, That we are unalterably opposed to the proposed diversion and distribution of aliens over the farming districts until immigration is rigidly restricted, numerically or otherwise."

Sixth: A Large Immigration Vastly Increases and Complicates Our Task of Americanization

The sudden outburst of patriotic desire to Americanize our unassimilated alien population was a direct result of the war. The nation came all at once to realize how vitally necessary it is to weld our heterogeneous population into a more homogeneous whole. The problem of illiteracy among our native-born, serious enough itself, has been very greatly complicated by allowing millions of aliens who cannot speak, or understand, or read English to land on our shores. The first stage in making Americans out of our foreign-born population must be to give them a speaking and reading knowledge of English. There is a limit to our national power of assimilation. To allow immigration to continue in the years to come at its prewar rate, or at what will doubtless be an even higher rate, is like trying to keep a boat bailed out without stopping the leak. A further restriction of immigration is a necessary and logical part of the Americanization program.

One of the most significant statements regarding the bearing of recent immigration upon the general problems of assimilation and of Americanization was that made by the November Grand Jury of King's County, N. Y. This body, on Dec. 3, 1920, handed to County Judge May a presentment urging legislation by Congress to "prohibit the immigration into this country of all who cannot read and write English and who do not possess an intelligent understanding of the fundamental ideas of human liberty."

"The stream of our national life," the presentment continued, "cannot rise higher than its source. To permit any further pollution of this stream is to intensify both our foreign as well as our domestic problems. It will foster disunion, instead of promoting union. Instead of continuing as a nation of high ideals, we shall degenerate into a mere medley of races, a hodgepodge of nationalities."

These are strong words, but everyone who has studied our national and municipal problems knows that they are true.

Seventh: The Ethics of Immigration Restriction

When refugees from war-stricken Europe are mentioned, there naturally arises in our minds the thought, "Is it right for us to prevent any of these people from coming here? Is it not un-American; contrary to our 'traditional' policy of providing 'a refuge

for the oppressed?' " Sentiment can never solve great national problems. The indiscriminate kindness which we may seem to be able to show to the coming millions of European and Asiatic immigrants can in no conceivable way counter-balance the harm that these people may do to our race, especially if large numbers of them are mentally and physically unfit.

Indiscriminate hospitality to immigrants is a supremely short-sighted, selfish, ungenerous, un-American policy. It may give some of us, for the moment, a comfortable feeling that we are providing a "refuge for the oppressed." But that is as narrow a state of mind as that which indiscriminately gives alms to any person on the street who asks for money. Such "charity" may, truly, produce a warm feeling of personal generosity in the giver himself. But alms-giving of this sort does more harm than good. It is likely to pauperize him who receives, and it inevitably increases the burden of pauperism which future generations will have to bear. We have no right to saddle any additional burdens upon the already overburdened coming generations of Americans. It is in the highest degree un-American for us to permit any such influx of alien immigrants as will make the process of assimilation and amalgamation of our foreign population any more difficult than it already is. The situation is discouraging enough already.

Our policy of admitting freely practically all who have wished to come, and of encouraging them in every possible way to come, has not only tremendously complicated all our own national problems but has not helped the introduction of political, social, economic and educational reforms abroad. Indeed, it has rather delayed the progress of these very movements in which we, as Americans, are so vitally interested. Had the millions of immigrants who have come to us within the last quarter-century remained at home, they would have insisted on the introduction of reforms in their own countries which have been delayed, decade after decade, because the discontent of Europe found a safety-valve by flying to America. We are constantly told by our idealists that the "cream" and the "pick" of Europe has been coming here because it is discontented at home; because it wants political and religious and economic liberty; because it wants education, and better living conditions, and democratic institutions. Have we in any way really helped the progress of these reforms by keeping the safety-valve open? By allowing the discontented millions of Europe and of Asia to come here now, are we likely to hasten, or to delay, the coming of political and social reforms in Armenia, in Russia, in Turkey? Our duty as Americans, interested in the world-wide progress of education, of religious liberty, of democratic institutions, is to do everything in our power to preserve our own institutions intact, and at the same time to help the discontented millions of Europe and of Asia to stay in their own countries; to shoulder their own responsibilities; to work out there, for themselves, what our own forefathers worked out here, for us and for our children.

Eighth: The Necessity for Further Restrictive Legislation

Our existing general immigration law was never designed to meet the present emergency. It is a selective, rather than a restrictive, measure. When it was enacted it was thought sufficient. But now the whole situation has changed. From all sorts and conditions of people, the country over, comes a strong and increasingly vehement demand for further legislation which shall effectively cut down the alien invasion which threatens us. Opposition to further legislation is limited to certain racial groups which are chiefly interested, not in the future of America but in the future of their race in America; to exploiters of "cheap labor," and to those who have been well termed "the incurable sentimentalists."

The House of Representatives, in December, passed a bill which has been widely, and most inaccurately,

termed a one year total exclusion bill. The measure, known as the Johnson bill, does not suspend immigration. It would limit it, for a period of one year after enactment, to the near blood-relations of naturalized citizens of foreign birth, and of aliens who apply for naturalization. What the numbers of these relatives may be, no one can tell, but it is perfectly safe to say that several hundreds of thousands of immigrants could be admitted if the bill became law. Further, there are provisions for the admission of unskilled laborers, and of domestic servants, and for the suspension of the illiteracy test in certain cases. The measure, then, while giving us more restriction than we have at present, is in no way drastic, and by no means meets the emergency. The Senate has, at present writing, taken no action.

That additional legislation is needed, and needed at once, is the conviction of every competent and unprejudiced student of our immigration problems. Among the many suggestions which have been made is the proposal which rests on the conviction that one of the best evidences that our different groups of foreigners have been assimilated is that they have become naturalized. The plan is to limit the number of new alien arrivals who shall be admitted from a country in any one year to a certain percentage of our previous immigrants from that country who have since become naturalized in the United States. According to the provisions of some of these bills, the exact percentage, within certain fixed limits, is to be determined by the Secretary of Labor, or by a commission, with reference to the labor conditions which may exist at the time. Such a plan has the merit of being more than a temporary measure; of being simple, direct and logical, and also of being sufficiently elastic to respond to varying economic conditions.

There is no subject before Congress of equal importance to that of immigration, which touches our National life in so many ways. Immigration has far-reaching economic and political effects, but its effects upon the character of the race are the most important of all. Congress will act, and act wisely and quickly, if the will of the great mass of our people who believe in restriction makes itself felt. But if we do not bestir ourselves, the steamship companies, and the large employers of "cheap labor," and the societies of foreign-born hyphenates will carry the day, as they have so often done in the past.

The economic aspects of immigration are those which are still given the most prominence, and which attract most public attention. Those of us who are concerned chiefly with problems of heredity and who demand a far more careful selection of the incoming aliens on the basis of their mental and physical condition, are, however, entirely in accord with those who ask for a further numerical restriction for economic reasons. Two things are absolutely essential. The first is a rigid and impartial enforcement of the existing law regarding the exclusion of mentally and physically undesirable aliens. The second is a radical reduction in the numbers of aliens who shall be admitted to the United States in any year. It cannot be too often or too strongly emphasized that, as Dr. T. W. Salmon pointed out several years ago, any measure which checks the flow of immigration in general must necessarily result in the admission of fewer mentally and physically undesirable immigrants. Further, with a reduction in the numbers, medical and general inspection can always be far more effective, and the aliens with mental and physical defects which render them highly undesirable as contributors to the blood of the American stock can be more often detected and debarred. Thus those who are primarily concerned about the character of the future American people have every reason for uniting with those who are chiefly interested in the purely economic aspects of alien immigration in demanding (1) a strict enforcement of existing law, and (2) a radical reduction of the numbers of aliens who shall be permitted to enter the United States. *Jan. 1, 1921.*

ARE VALENCIA ORANGES FROM CHINA?

The Occurrence in South China of Oranges Closely Resembling Strains of the Valencia Variety Suggests the Latter's Origin There

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THE introduction of the Valencia orange into Florida and California is a subject which has been fully discussed and is a matter of definite record by Shamel, Scott and Pomeroy.[4] To briefly summarize their findings: The variety was introduced into California about 1876 by the Thomas Rivers Nurseries of London, England. The name of the variety having been lost, it was later identified by a Spanish orange grower visiting in California, as a variety grown in Spain called "La Naranja Tarde de Valencia." After that the name Valencia was adopted for the variety in California. Previous to 1876 the same variety had been introduced into Florida where it was known by the names "Brown" and "Hart's Late." Trees of these introductions were later shipped to California and when they came into bearing the fruits and trees were found to be identical with those of the variety grown in that state under the name Valencia.

TWELVE STRAINS OF THIS VARIETY

No definite evidence is available concerning the history of the variety prior to its distribution by the Rivers Nurseries. The Valencia variety, as cultivated in the United States, does not represent one single strain; investigations conducted by the Office of Horticultural and Pomological Investigations, U. S. Department of Agriculture, have revealed that there are twelve important strains within this variety.

In 1918 the senior writer visited southern China in continuance of citrus canker studies. At Sunwui, Kwangtung Province, near Hong Kong, fruits were observed which very closely resembled one strain of the Valencia as grown in California, and fruits were collected as specimens for identification in Washington. At Kua Tscha near Swatow, Kwangtung Province, trees of the sweet orange were observed which also bore fruits resembling another strain of the Valencia orange. Fruits and foliage of these trees were collected but unfortunately the foliage specimens moulded and were discarded. The foliage was, however, of the same type as that which in general characterizes the Mediterranean varieties of the sweet orange (*Citrus sinensis*). Trees both at Sunwui and at Kua Tscha were photographed and one is shown in an accompanying figure. The trees were grafted upon a native mandarin orange (*Citrus nobilis*) stock, which apparently dwarfed them to some extent. At Sunwui, the growers, questioned as to where the bud wood was obtained, stated that they bought their trees already budded from a nearby locality. The nurserymen, questioned as to where they had obtained these buds, stated that they had for many years obtained them from nearby trees. Apparently they did not recog-

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[2] Now General Manager, California Nurserymen's Bud Selection Association, San Jose.
[3] The writers express their thanks to Mr. T. Ralph Robinson of the Bureau of Plant Industry, U. S. Department of Agriculture for assistance in connection with this paper.
[4] Shamel, A. D., Scott, L. B., and Pomeroy, C. S. Citrus Fruit Improvement: A Study of Bud Variation in the Valencia Orange. U. S. Dept. of Agr. Bull. No. 624.

ORANGE FRUITS FROM SUNWUI, CHINA

These fruits, carried to Washington from Sunwui, China, were found to agree in appearance and detailed characters with fruits of the Long strain of the Valencia variety orange as grown in California. Their texture is somewhat rougher than the Smooth strain, the juice abundant and sweet and the color a bright orange; seeds average one to two per fruit. (Fig. 20.)

"SOH KAA" OR "COOLIE ORANGES" FROM KUA TACHA, NEAR SWATOW, CHINA
These fruits resemble the Smooth strain of Valencia oranges in their detailed characters, but are smaller. The rind is very thin, juice sweet and abundant, and the color a reddish orange. (Fig. 21.)

ORANGE TREE AT SUNWUI NEAR HONGKONG, CHINA

The fruits of this tree resemble the smooth strain of the Valencia variety; the habit of growth and foliage characteristics are also similar. The long white leafless canes in the foreground are mulberry bushes, which in China are frequently interplanted between the rows of citrus orchards. (Fig. 22.)

nize it as a distinct variety among the sweet oranges.

At Kua Tscha the nurserymen were questioned as to the origin of the bud wood. They did not recognize the trees bearing these fruits as belonging to a distinct variety; they merely obtained bud wood from nearby trees of the locality. All sweet oranges (*Citrus sinensis*) were called "Soh Kaa," which translated means "coolie orange," and there seemed to be no special name for this variety in this locality. None of the growers knew of the time of the advent of this orange into their locality and seemed to regard it as having been the usual fruit for years

The above information was obtained through the very kind and explicit interpreting of Mr. Chang, Interpreter of the American Consulate, Swatow.

SIMILAR FRUITS FROM CHINA

The fruit specimens collected at Sunwui and Kua Tscha were carried to Washington for determination. Examination by the junior writer evidenced that they corresponded very closely with the descriptions and detailed characters of the Smooth and Long strains of the California Valencia variety as described by Shamel, Scott, and Pomeroy in the publication previously mentioned. The fruits were, of course, not in the best of condition, having been six weeks en route from Hong Kong to Washington without

refrigeration; the fruits are shown in accompanying photographs. The description of these fruits follows:

The Soh Kaa from Kua Tscha: The trees of the strain from Kua Tscha have an upright, spreading habit of growth. The foliage and other tree characteristics are similar to those of trees of the Smooth strain. The fruits are smaller than the fruits of the Smooth strain, but have somewhat the same shape; texture of skin smooth; color reddish orange; rind very thin; rag tender; juice abundant, sweet; seeds averaging a few to each fruit. The fruits agree in description very closely with fruits of the Smooth strain.

The Sunwui fruits: The habit of growth and foliage characteristics of the trees are similar to those of the Valencia and Long strains. The fruits are cylindrical and long; size, small to medium; texture somewhat rougher than Smooth strain; color bright orange; rag tender; juice abundant, sweet, of good quality; seeds averaging 1 to 2 per fruit. The fruits agree very closely in description with fruits of the Long strain.

Chinese growers are not active along the lines of plant introduction and the adoption of methods and ideas from the Occident is slow. It is hardly probable therefore that we are dealing in China with introductions from America.

Sunwui, the point at which one of these strains was discovered, is situated in the delta of the Canton River, and but four or five miles from the city of Kong Moon. Various histories of China record the activities of Spanish and Portuguese merchants at the port of Kong Moon in the early days of foreign trade with China. The interest of such traders in economic plant materials is shown by the many definitely recorded plant introductions made to and from the Philippines. The Spanish, moreover, apparently were especially interested in orange culture, for wherever they colonized orange culture followed them. Thus a map showing where orange trees have become established would coincide very closely with a map showing the Spanish expansion in the 16th, 17th and 18th centuries.

The finding of these strains of an orange in South China, similar to certain strains of the Valencia in the United States, is suggestive of the origin of the Valencia in China and that it was carried from there to Spain, Portugal, the Azores or other Mediterranean countries by the Spanish or Portuguese traders. In one of these countries it was found and subsequently went to Florida and California through the agency of the Rivers Nurseries.

SCIENCE AT SECOND HAND

THE ALMOSTS: a study of the feebleminded, by Helen MacMurchy. Pp. 178, price $1.50. Boston, Houghton Mifflin Co., 1920.

Miss MacMurchy strikes her keynote in her first sentence: "Sometimes the poet sees more than the scientist, even when the scientific man is playing at his own game." If fiction had been more carefully studied, she avers that "we might have come sooner to some of the alleged discoveries of the twentieth century." One of these alleged discoveries is apparently the fact of feeblemindedness; and to atone for the neglect of past fiction readers, Miss MacMurchy has diligently studied Shakespeare, Bunyan, Scott, Dickens, Bulwer Lytton, Charles Reade, and a dozen others down to Kate Douglas Wiggin and the Contributors Club of the Atlantic Monthly.

"Touchstone is probably mentally defective, but it is quite possible that the fool in 'Lear' may have been insane, though certain of his words and actions remind one forcibly of a mentally defective person." And so on. Those who like to study human nature thus far removed from reality will like the book. The last chapter is a sentimental statement of "The Case for the Feebleminded" which, while containing nothing new, is on the whole sound. The writer urges custodial care and every endeavor to make the feebleminded "happy, safe, and useful." P. P.

A CASE OF INHERITED SYNDACTYLY IN MAN

Ralph G. Hurlin

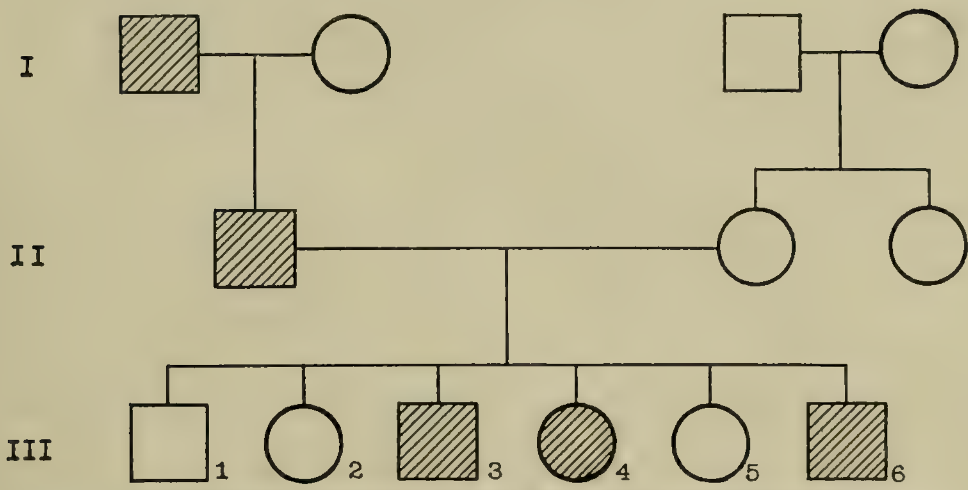
Russell Sage Foundation, New York

THE following account of the inheritance of limited syndactyly through three generations is reported for the purpose of placing the case on record. Syndactyly, or webbed digits, is recognized as a dominant Mendelian trait in man and a number of instances of its inheritance have been reported before. There appears, however, much variation in the number of digits affected and in the extent of the web along the digits, in view of which full recording of such pedigrees is worth while.

In this family the web occurs only on the feet and only between the second and third toes. In each case it is present on both feet. The character of the web is indicated by the accompanying X-ray photograph, Figure 23. The skeleton is entirely normal, but the second and third digits are united be-

X-RAY PHOTOGRAPH OF WEBBED FOOT

This is a case of limited syndactyly. The web occurs in this family only between the second and third toes, and was present in each case on both feet. This photograph shows plainly the joining of the second and third digits beyond the first joint. (Fig. 23.)



INHERITANCE OF WEBBED FEET IN THREE GENERATIONS

The shaded symbols indicate the persons having webbed digits. In the first generation, the father transmitted the character to his only son, who in turn transmitted it to three of his six children—two sons and a daughter. (Fig. 24.)

yond the first joint by fleshy parts.

The inheritance is represented in Figure 24, in which squares indicate males, circles females, and shading the presence of the web. The trait cannot be traced back of the paternal grandfather, who is represented by the shaded square in generation I in the diagram. He had transmitted it to his only child, a son, who passed it to half of his offspring. Of the six children in generation III, two sons and one daughter exhibit the web. The Mendelian expectation happens to have been exactly fulfilled.

The web is known to have been well defined in the case of the grandfather. In the father the condition is described as similar to that shown in the photograph, with slightly greater extent on the left than on the right foot. In the third generation, in child number 3 the condition is that photographed; in number 6 the web is somewhat less pronounced; and in number 4 it is reported as distinct but not especially noticeable.

This inheritance occurs in a branch of an old New England family whose genealogy has been fully investigated and published. The grandfather here mentioned was one of ten children and his father one of six. Yet it has not been possible to discover that this supposedly dominant trait occurs in any of the collateral lines. The possibility is suggested that the trait may frequently exist, as happens in one member of this third generation, as a slight and not particularly noticeable web.

Sex Attraction, by Victor C. Vaughan, Sc.D., M.D., LL.D., professor of hygiene and physiological chemistry, and dean of the University of Michigan School of Medicine, Ann Arbor, Mich. Pp. 44, price 50c. St. Louis, C. V. Mosby Co., 1920.

In this lecture Dr. Vaughan describes briefly the evoluton of sex and the basis of the physiological attraction between the sexes in the human species at the present time. The point of view is that of the eugenist. Emphasis is laid on sex education, and proper sexual selection.

RACIAL DIFFERENCES IN MORTALITY

By an analysis of census figures, Louis I. Dublin and Gladden W. Baker discover significant differences in the mortality of various racial stocks in Pennsylvania. Their study is reported in the *Quarterly Publication* of the American Statistical Association, March, 1920.

Differences of this kind have an important bearing on evolution, and on the future composition of the American population. The conclusions which the authors reach are:

1. Of the three main groups of the white population in Pennsylvania and in New York—(*a*) native born of native parents, (*b*) native born of foreign or mixed parentage, and (*c*) foreign born—the first has the lowest mortality. This is true for both sexes and for virtually every age period, but is most marked at the adult ages.

2. The foreign born, and the native born of foreign or mixed parentage, agree much more closely with each other than with the native stock. An interesting exception presents itself however, at the ages from 25 to 44 during which period the foreign born have a great advantage over the native born of foreign or mixed parentage. The reason for this is the predominance of the Irish, German and British stocks among the first generation Americans at this age period. After the age of 45 these two groups of the foreign stock are of the same racial extraction and their death rates are in very close agreement.

3. The death rates of the component groups among the foreign born vary considerably. The Austro-Hungarians, Russians and Italians present altogether favorable conditions, while the British, Germans and Irish show death rates very greatly in excess. This is especially true of the Irish whose mortality is about double that of the native stock. The death rates for the Germans, British and Irish are much higher in America than in their own countries. Pulmonary tuberculosis, pneumonia and the degenerative diseases, including heart disease, Bright's disease, and cancer, are largely responsible for this unfavorable mortality.

4. The findings of the previous study for New York State are confirmed. The unfavorable conditions of life and work among foreign races to which attention was directed in the study for New York are found to prevail in Pennsylvania as well. The facts emphasize the necessity for special public health work for the people of foreign origin. The much more favorable economic conditions under which they live in the United States than in their own countries should result in lower death rates. But in several instances we found that this does not prevail; the facts indicate, on the whole, deterioration rather than improvement. Is it possible that our immigrants are not representative of the best in their native countries? It has often been supposed that the immigrants comprised the most vigorous among their own people; the results however, do not confirm this impression, but suggest many questions for further inquiry.

5. It is very important that a study similar to this one be carried out as soon as the final results of the 1920 census are available, to determine whether any differences of importance have appeared in the interval of ten years.

Good Practical Eugenics

The Book of Marjorie. Pp. 128. New York, Alfred A. Knopf, 1920.

This anonymous and charming book, apparently written by a New York newspaper man, is one of the best pieces of practical eugenics propaganda that has come to light for some time. It is the story of the author's love and marriage, and of the days when he and Marjorie awaited the birth of their first child. As a sane, interesting, modern, wholesome study of the psychology of married life, and of expectant parenthood, it is almost in a class by itself. The book is worth reading.—P. P.

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

VOL. XI, No. 8 — NOVEMBER-DECEMBER, 1920

CONTENTS

The JOURNAL OF HEREDITY is published monthly by the American Genetic Ass'n.
Publication office, 450 Ahnaip Street, Menasha, Wis.
Editorial and general offices, Washington, D. C.

The JOURNAL OF HEREDITY is published by the American Genetic Association for the benefit of its members. Canadian members who desire to receive it should send 25 cents a year, in addition to their regular membership dues of $3.00, because of additional postage on the magazine; foreign members pay 50 cents extra for the same reason. Subscription price to non-members, $3.00 a year, foreign postage extra; price of single copies, 35 cents.

Date of issue of this number, April 19, 1921.

A NEW HYBRID—THE KATHARINE BLUEBERRY

The illustration shows, in natural size, a quart box of fruit from a new hybrid blueberry which is given the variety name Katharine. The variety is a first generation hybrid between two selected wild plants of the highbush blueberry, *Vaccinium corymbosum*. One of these parents, known in our records as Brooks, was from Greenfield, N. H. The other parent, known as Sooy, was from Browns Mills, N. J. About 3,000 hybrids of this parentage, from pollinations made in the greenhouse at Washington in 1912 and 1913, have been fruited at the blueberry testing plantation at Whitesbog, four miles east of Browns Mills, N. J., which is under the supervision of Miss Elizabeth C. White. The best hybrid among these 3,000 is the one here illustrated. The photograph, taken July 18, 1918, shows a clean picking of all the berries that were ripe on the bush at that date, small as well as large ones. Less than 3% of the berries, by count, were under half an inch in diameter. The largest was ¾ of an inch. The berries have a light blue color, delicious flavor, and firm texture, and the seeds are so small as to be scarcely noticeable when the berries are eaten. Propagation material of this variety has been given to several nurserymen, as hybrid 830C, and plants should be available within a year or two. The type specimen of the variety has been deposited in the Economic Herbarium of the U. S. Department of Agriculture and a colored drawing of its fruit has been filed in the records of the American Pomological Society, in Washington. The name Katharine is given in honor of my daughter, Mrs. Katharine C. Woodburn, now of Des Moines, Iowa, who took a deep interest in the development of the blueberry and at one time did all the pollination work.—Frederick V. Coville, United States Department of Agriculture. (Frontispiece.)

IS RACE SUICIDE POSSIBLE?

ALEXANDER GRAHAM BELL
Washington, D. C.

ONE of the most interesting of the questions of today relates to the powerful influence exerted upon populations by what we might almost call negative selection. A selection that produces the very opposite of that expected.

For example, no inheritable peculiarity associated with lack of offspring can be made to grow and flourish in a community. In spite of all efforts it will languish, and promote the growth of its very opposite. History is full of illustrations.

CELIBACY

After the fall of the Roman Empire there was a great religious revival among the nations. The Middle Ages saw Europe filled with monasteries and nunneries, where enormous numbers of people took vows of celibacy, and renounced all home and family ties. Even outside of the religious houses the *celibate life* was everywhere held up as the ideal one to be followed by the best and purest elements of the population.

Instead of helping the church this produced the very opposite effect, and actually paved the way for the Reformation! Large masses of the people who were most attached to the Church led celibate lives, and left no descendants, whereas the independently minded who were not so devoted to the Church were not limited in their reproduction.

As to the more general effects it may be safely said that the worship of celibacy during several hundreds of years in the past has not tended to the improvement of humanity but the very reverse; for, where the best and noblest led celibate lives, they left no descendants behind them to inherit their virtues, whereas the worst elements of the population continued to multiply without restriction.

It is now felt that the interests of the race demand that the best should marry and have large families; and that any restrictions upon reproduction should apply to the worst rather than to the best.

It is of course useless to expect that the worst would take vows of celibacy or keep them; and the realization of this has led to all sorts of impracticable schemes to prevent or restrict their reproduction by compulsory means.

The great trouble about all these schemes, apart from their impracticability, is that they aim simply to prevent degeneration. They aim to prevent the race from moving backwards, but do not help it to move forwards. The only hope of producing higher and better types of men and women lies in the multiplication of the better elements of the population.

There is one very promising feature about the present situation, and that is that the best are readily attracted by high ideals. Give them a new ideal, and many will follow it, especially if they believe that duty points in the same direction. Convince them that the interests of the race demand that the best should increase and multiply; convince them that it is therefore their duty to marry, rather than lead celibate lives. Depose "celibacy" from the high and commanding position she has occupied for so many hundred years, and put "marriage" there instead as the ideal to be held up before the best and noblest of the race. Marriage, with marriage vows as sacred as the former vows of celibacy. Nature demands this in the interests of the race. For the extreme helplessness of the human infant necessitates parental care for very prolonged periods of time—in fact at least from infancy to the beginning of adult life—and this involves the permanency of the marital tie on the part of the parents, especially where a number of children are produced.

RACE SUICIDE

At the present time considerable alarm has been expressed at the apparently growing disinclination of American women to bear children, and a cry has been raised against what people call "Race Suicide." Whatever the cause —it is undoubtedly the fact that in America the children of foreign-born parents are increasing at a much greater rate than the children of native-born parents—and the position is sufficiently grave for serious consideration.

The desire to avoid maternity is a characteristic associated with lack of offspring, and cannot therefore go on increasing indefinitely in a community. Its natural tendency is to die out through lack of offspring to inherit it, leaving the more fertile part of the community alone to propagate the race.

Reflection therefore leads to the somewhat startling conclusion that even wholesale abstention from children, so far from lessening the fertility of the community as a whole will eventually increase it instead. Actual race suicide will not result from such a cause alone, so long as the race is left to itself to work out its own destiny.

Just consider the case of a race of people in which the women show a disinclination for motherhood, surrounded by prolific immigrant races ready to take its place, then of course there would be serious danger of the native race being displaced by the immigrants. The immigrants might absorb the native race instead of the native race absorbing the immigrants; but such a result would be due to the presence of the competing races and not due directly to the operation of natural causes within the race itself.

THE DESTINY OF AN ISLAND RACE

In order to appreciate this, imagine our native race to be placed upon an island protected by suitable immigration laws from competition with other races. Then it becomes obvious that the sentiment in favor of avoiding the production of offspring must necessarily diminish in process of time, on account of the lack of offspring to inherit it; and that the opposite sentiment of a desire to have children will grow, and ultimately become predominant, because each succeeding generation will be composed exclusively of the descendants of the people who had children. If the desire for offspring is an inheritable characteristic, *and it certainly is*, then of course the next generation will inherit it from their parents to a certain extent; whereas there will be no descendants at all to inherit the characteristics of those who abstained from offspring.

We have placed the people upon an island, and protected them from interference from other races, so as to leave them to themselves to carry on their lives in their own way, as they desire.

Some of these people love little children, and desire to have children of their own. Others look upon children as nuisances, perhaps necessary evils for the continuance of the race—but why should they be bothered with them when they don't want them? Let others have them if they want them, but leave *them* alone. Well—let them have their desires.

Let those who desire children have them, and those who don't, have none, and see how it will all work out.

Now does it not become at once evident that so long as any of the people desire offspring and have them, complete race suicide is impossible? Some offspring will be produced and a second generation will appear.

Suppose for example the boom against maternity reaches such proportions that 99 per cent of the population decide to have no children—and surely this is an extreme case—will the race die out? No—not immediately at all events. There will be another generation composed exclusively of the descendants of the one per cent who desire to have children. The whole of the next generation will be composed of their children; and there will be no descendants at all of the other ninety-nine per cent.

This is the critical time for our islanders. Only one per cent of the

population have had children, and of course the numbers in the next generation will be so seriously reduced that immigration from outside would speedily swamp them—but we have agreed to protect them from this competition with other races, and leave them alone to work out their destiny to the bitter end.

Well, let us revisit the island after the original population has passed away. We find the population now only a fraction of what it was before; and the question naturally arises: will the population continue to diminish at each successive generation until actual race suicide results?

It is not to be supposed that the sentiment against maternity will disappear in one generation. The second generation will therefore undoubtedly continue to be divided upon the question of maternity; some wishing to have children, others not; but the *proportion* desiring children will necessarily be greater, on account of heredity, than in the original population; for the whole of this second generation are descended from the one per cent who desired offspring, whereas the ninety-nine per cent who did not desire them left no descendants.

There seems to be no escape from the conclusion that in this second generation more than one per cent of the people will desire children, and less than ninety-nine per cent will abstain from their production. Therefore the proportion of the second generation who will have children will be greater than in the first, and the proportion opposed to maternity will be less.

Thus in each succeeding generation the proportion who desire children and have them will increase, and the proportion avoiding maternity diminish, with the net result that each succeeding generation will be more fertile than the last. The desire to avoid maternity will die out to a great extent on account of the lack of offspring to inherit it. *The spirit of race suicide will itself commit suicide, and leave a more fertile race than before.*

The only thing that could prevent such a result would be: the admission of immigrants during the period of declining birthrate.

This indeed is the critical period in the history not only of our hypothetical islanders, but of every nation similarly situated. When therefore a nation reaches a stage where it finds its own birthrate declining, and immigrants with a much larger birthrate flocking into the country, the time has come for very serious consideration as to the means to be taken for self-preservation.

The United States is today in this critical position. The birthrate of America is declining; the spirit of avoiding maternity is on the increase; and the immigrant races are increasing at a much greater rate than our own. The only hope for a truly American race lies in the restriction of immigration.

EUGENICS AND PATRIOTISM

"Race has played a far larger part than either language or nationality in moulding the destinies of men; race implies heredity, and heredity implies all the moral, social and intellectual characteristics and traits which are the springs of politics and government. . .

"The moral tendency of the heredity interpretation of history is for our day and generation, and is in strong accord with the true spirit of the modern eugenics movement in relation to patriotism, namely, the conservation and multiplication for our country of the best spiritual, moral, intellectual and physical forces of heredity; thus only will the integrity of our institutions be maintained in the future."

—*Henry Fairfield Osborn.*

A HEN WHICH CHANGED COLOR[1]

A Note on the Hereditary Behavior of a Normal Blue Andalusian Hen Whose Feathers Changed to Snowy White

William A. Lippincott

Kansas Agricultural Experiment Station, Manhattan, Kansas

CASTLE and Phillips' (1911) studies on ovarian transplantation in guinea-pigs have been most useful as classroom illustrations of the separateness of the soma and germ-plasm. They have conveyed to the elementary student as no amount of explanation might, just what the underlying principle of Weismanns' (1893) great concept was. These results are too familiar to biologists to need review.

In connection with a study of the inheritance of blue in poultry, the writer has observed a marked somatic change in a blue Andalusian hen, which, as was to be expected, did not in any way change the gametes she produced. Because the change was a rather striking one and might serve as an example of the independence of the body-plasm and germ-plasm from another point of view, it has seemed worth while to give a detailed account of the case.

What appeared to be a normal blue Andalusian hen was turned over to the writer in the early spring of 1917 by Professor J. G. Halpin of the University of Wisconsin. She came from the flock of the University Poultry Department and was then almost two years old. This hen was from a pedigreed family, among the members of which nothing unusual had been noted. She carried the University legband number C2032, and was, among others, used in breeding work carried on at the University during that spring.

In August 1917 she was taken to Kansas State Agricultural College at Manhattan where she has since been kept on the farm of the Department of Poultry Husbandry.

In October 1917 it was observed that white feathers were appearing on her neck and a little later that her developing primaries also were white. It was noted that new feathers were coming in in other regions of the body which were the normal blue, and by December 1st it was apparent that she had completed her molt for that season.

Her appearance on December 20, 1917, is shown in Fig. 1. There was no further noticeable change until the following July when it was observed that she was again in full molt, her old feathers both blue and white being replaced only by white. Photographs taken August 7, 1918, may be seen in Figs. 2, 3 and 4, which show her during the progress of her molt. Six weeks later she was snowy white throughout (Fig. 7). She has since never displayed a blue feather and is now (October 1920) in apparent good health and laying occasionally.

CAUSES OF COLOR CHANGES

Supposing that similar color changes among domestic birds were not uncommon, a search of the literature was made. While it has not been exhaustive, the writer has been surprised not to find, in the journals at his disposal, accounts of similar changes. The account of Finches' (1908) hen indicates that the color change was first due to loss of pigment from the feathers after growth and not to a failure of the pigment-manufacturing mechanism to function. The color change came after, and not as the accompaniment of, a molt. During a subsequent molt pigmented feathers were grown which later turned white. Whether the pigment forming mechanism was somewhat interfered with during this molt, or the bird passed through a partial molt only, is not clear.

[1] Contribution from the Department of Genetics, Wisconsin Agricultural Experiment Station, No. 25 and from the Department of Poultry Husbandry, Kansas Agricultural Experiment Station, No. 16.

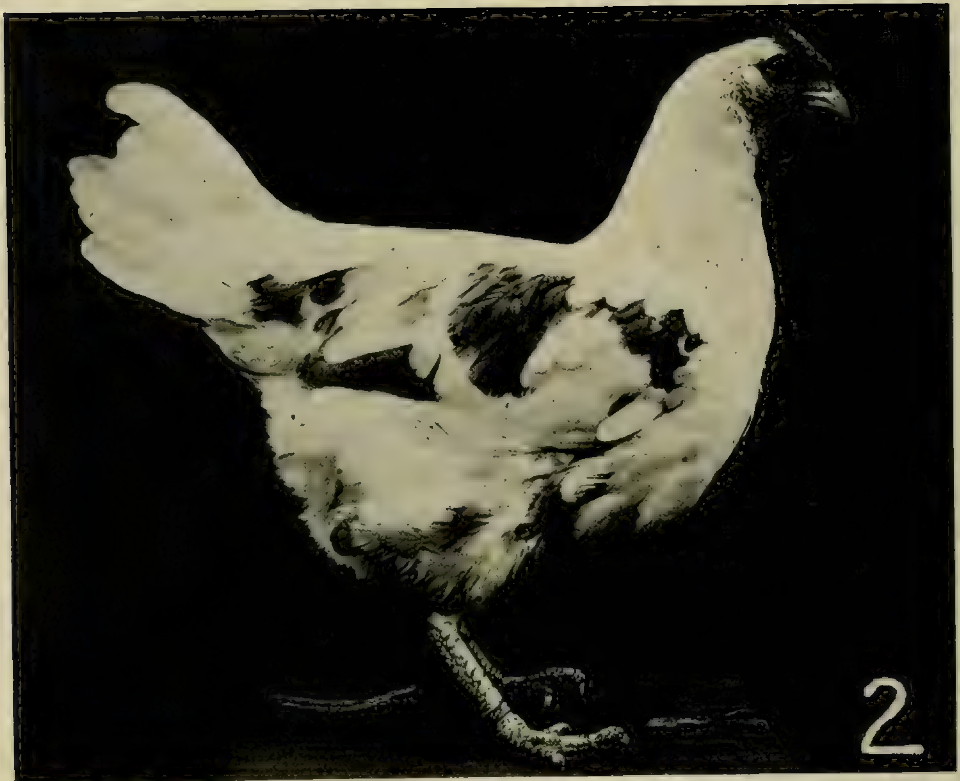
BLUE ANDALUSIAN HEN (C2032) CHANGING TO WHITE

This hen, from the University of Wisconsin Poultry Department, was considered in the spring of 1917 to be a normal blue Andalusian. In October of the same year white feathers appeared on her neck. The illustration shows her as she appeared December 20, 1917, after completing that season's molt. Photograph by James Machir. (Fig. 1.)

The particular interest in the case in hand arises not alone from the fact that the subject changed color but that in addition her ancestry and breeding performance are known.

As shown by Lippincott (1918) blue Andalusians are usually of the genetic constitution *PP* (*Re*) (*rE*). *P* is a factor necessary for the production of black pigment. Its allelomorph *p* produces a recessive white. *R* is a dominant, acting on black pigment, restricting its distribution in such a way as to give a characteristic bluish gray appearance. *E* is a dominant factor rendering an individual carrying *P* self colored. Self-blue is the result of the combined action of *R* and *E* on black pigment. For reasons developed in the paper noted, and in a further paper soon to be published, it appears reasonable to assume that *R* and *E* are each closely, perhaps completely, linked to the allelomorph of the other, hence written (*Re*) and (*rE*).

As shown earlier by Bateson and Punnett (1906), when blue Andalusians are mated *inter se* they produce blacks, blues, and white-splashed, in the ratio of 1 to 2 to 1. Genetically the reason



THE BLUE ANDALUSIAN HEN (C2032) EIGHT MONTHS LATER THAN FIG. 1

"There was no further noticeable change (from the condition shown in Fig. 1) until the following July when it was observed that she was again in full molt, her old feathers, both blue and white, being replaced by only white." These three views show the hen as she appeared August 7, 1918. No. 3 is a front view. A comparison of the two sides with regard to the order in which the blue feathers were dropped is a matter of considerable interest to poultrymen. Was the change in color due to loss of pigment from the feathers after growth or to a failure of the pigment-manufacturing mechanism to function? Photographs by James Machir. (Figs. 2 and 3.)

for this is shown in the following cross.

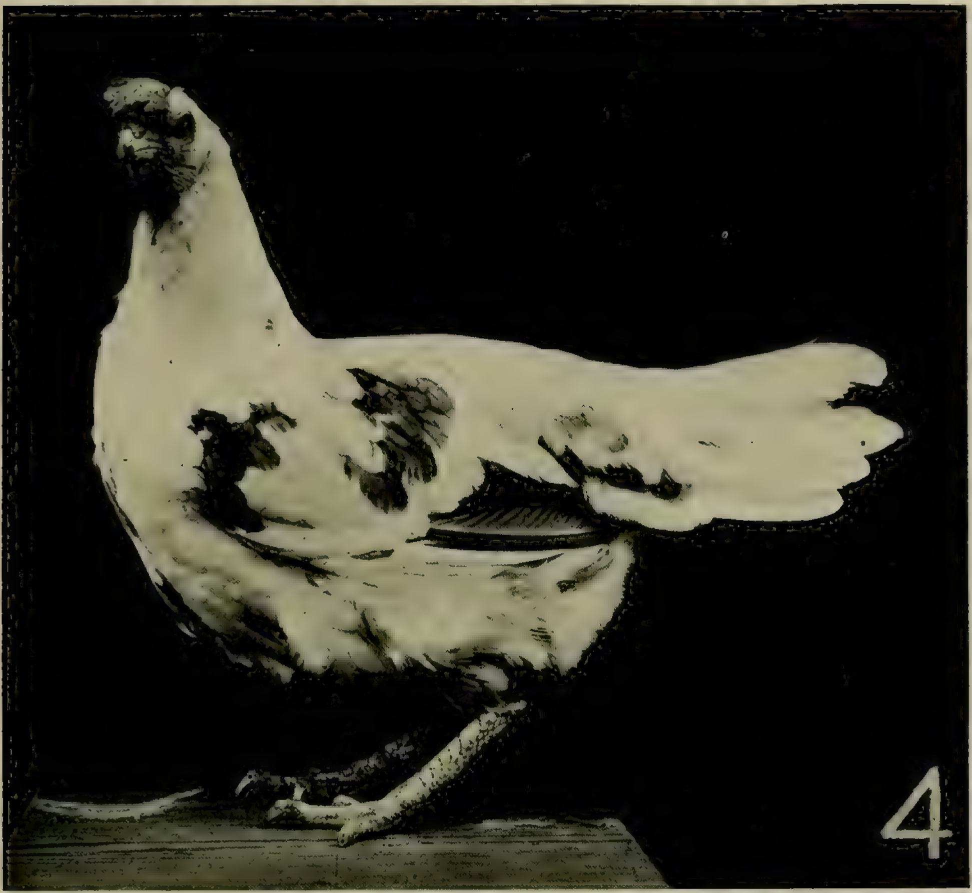
Blue Andalusian ♂ X Blue Andalusian ♀
PP(*Re*)(*rE*) *PP* (*Re*) (*rE*)

Offspring
- 1*PP*(*rE*) (*rE*) black
- 2*PP*(*Re*) (*rE*) blue
- 1*PP*(*Re*) (*Re*) white-splashed

The white-splashed individuals, as would be expected if the symbolism proposed is correct, are splashed with blue, and sometimes referred to as blue-splashed.

RESULTS OF BLUE AND WHITE MATINGS

During the spring of 1917 before C2032 had exhibited any tendency toward a color change, she was mated to a blue Andalusian, ♂ S19, from the



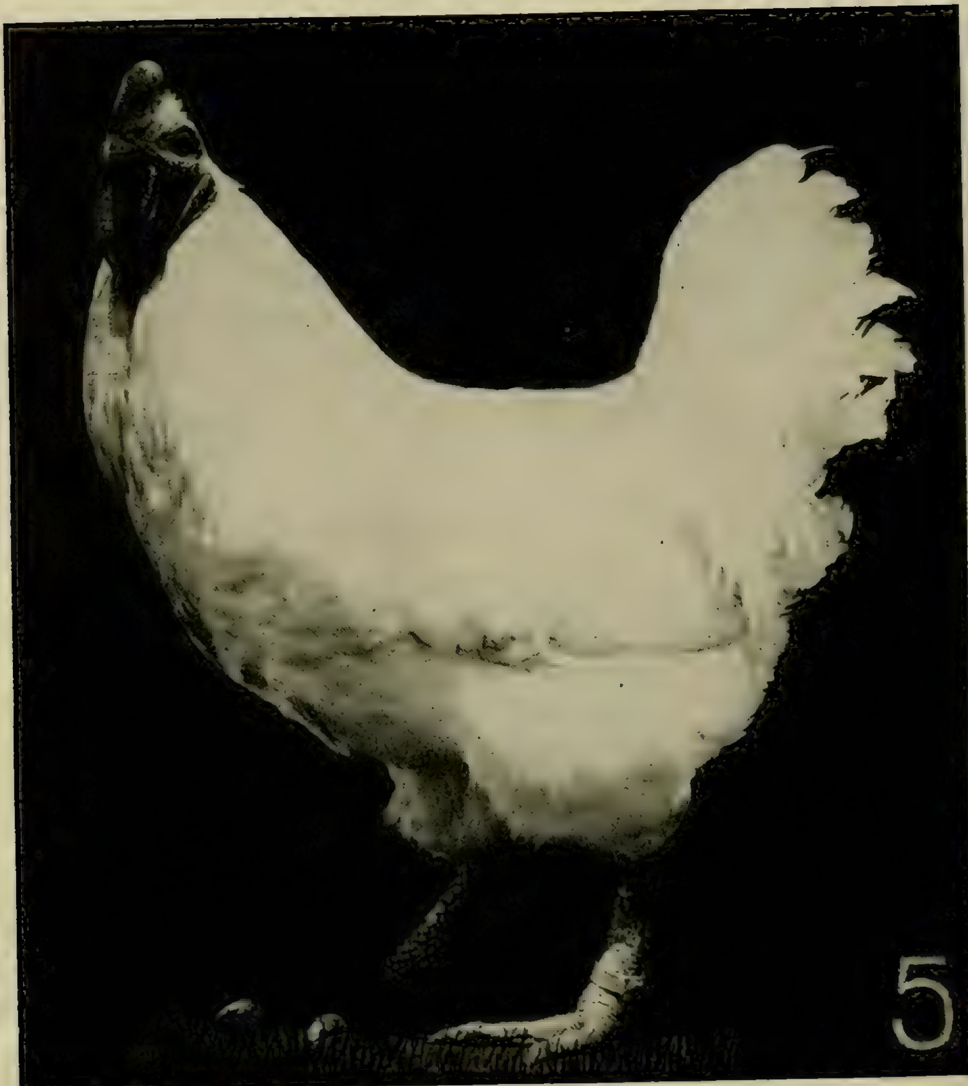
LEFT SIDE VIEW TAKEN SAME TIME AS THOSE ON OPPOSITE PAGE

The photographs on this and the opposite page were taken August 7, 1918, eight months later than the photograph reproduced in Fig. 1. Six weeks after the above condition obtained, all the feathers had changed to snowy white, a condition which the hen has retained to the present time. See Fig. 7. (Fig. 4.)

University of Wisconsin flock. But five chicks here hatched, of which one was blue-splashed and four were blue, the theoretical expectation being 1.25 splashed, 2.50 blue and 1.25 black.

The following year, 1918, while in the condition, as regards color, shown in Figure 1, she was mated with white Wyandotte ♂118M from the Kansas State Agricultural College flock. As shown in an unpublished paper the genetic constitution of 118M was $pp(rE)(rE)$, so far as the factors under consideration are concerned. The expectation from such a mating would be equal numbers of blues and blacks. Twenty eight chicks were hatched, of which thirteen were blue and fifteen were black.

The next breeding season, 1919, after C2032 had become pure white, she was mated to a white Plymouth Rock ♂155 M (see Fig. 5). Twenty five chicks were hatched, of which seven were blue and eighteen were black, the theoretical expectation being 12.5 for each color. This deviation is probably not significant since $\frac{\text{Dev.}}{\text{P.E.}}=3.2$. A black and a blue chick, offspring of this mating, are shown in Figure 6.



A WHITE PLYMOUTH ROCK (155M)

During the breeding season of 1919, the blue Andalusian Hen (C2032), after she had become pure white, was mated to this White Plymouth Rock (155M). Out of twenty-five chicks hatched, seven were blue and eighteen were black. Two of the offspring are shown on the opposite page. Photograph by James Machir. (Fig. 5.)

During the breeding season of 1920 she was mated with white Wyandotte ♂206M. This bird was similar in genotype to 118M and 155M except that he was heterozygous for I^p (inhibitor of pigment), a factor for dominant white. Nine chicks were hatched of which three were blue, four were black and two were white. The theoretical expectation would be 2.25 blue, 2.25 black and 4.50 white.

It is evident that C2032, though snowy white, was continuing to breed as a blue Andalusian. A genetically recessive white female mated to the white Plymouth Rock used would have

A BLUE-BARRED AND A BLACK-BARRED CHICK

These two chicks were among the offspring from the mating of white Plymouth Rock 155M and blue Andalusian C2032 during the season of 1919. The barring factor was brought in by the male. "It is evident that C2032, though snowy white, was continuing to breed as a blue Andalusian." Photograph by James Machir. (Fig. 6.)

produced only white chicks, unless it was the kind of white peculiar to the Japanese Silky. A genetically dominant white female would also have produced only white offspring, if she were homozygous. If she were heterozygous dominant white but homozygous for *P*, half her chicks by a white Plymouth Rock would have been white and half pigmented. Other possible combinations might be suggested, but none fits the case except the assumption that she is genetically a blue Andalusian though a beautiful snowy white in appearance. A similar conclusion is reached from the results of her mating with white Wyandotte ♂ 206M. A photograph of the hen after she had become completely white is shown on the following page.

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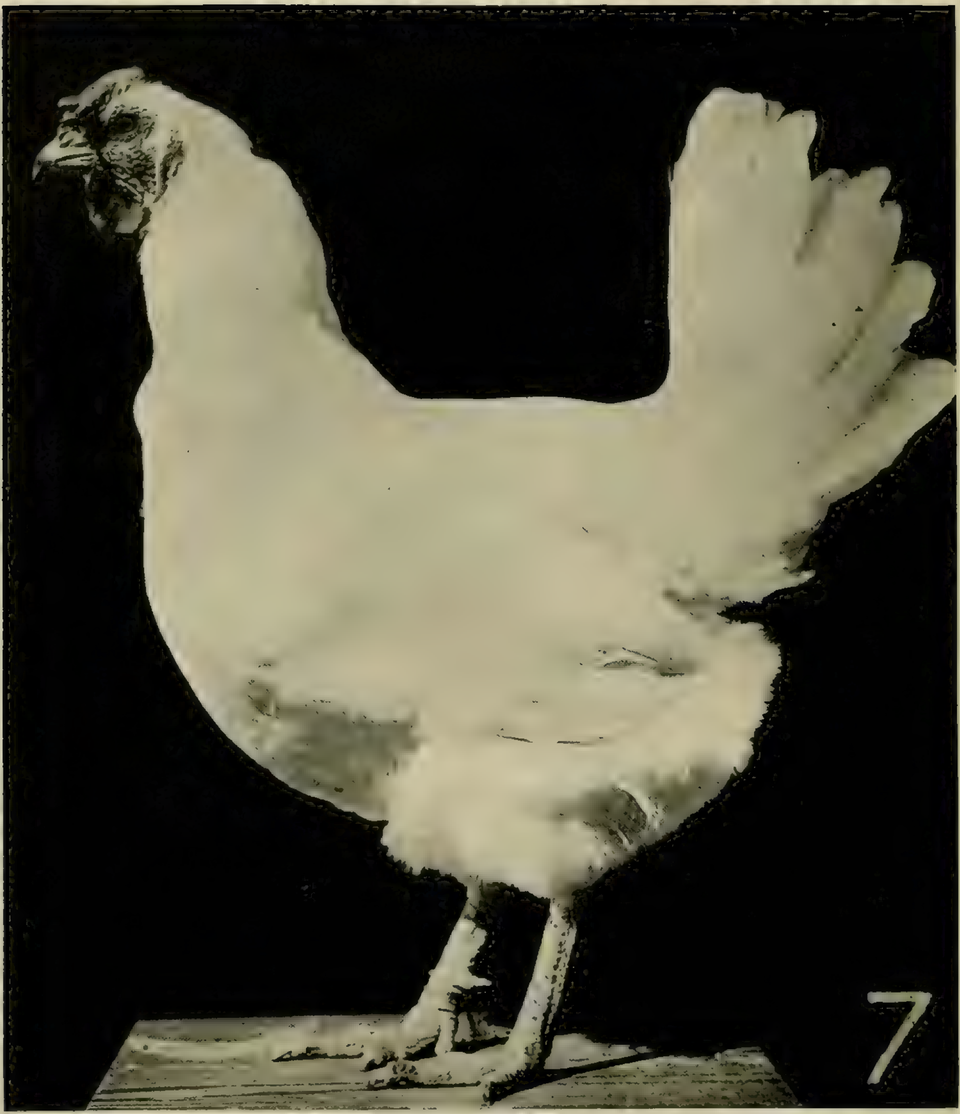

BLUE ANDALUSIAN HEN (C2032) CHANGED TO SNOWY WHITE

This photograph was taken September 21, 1918 after the hen had completed her annual molt, and shows her condition six weeks after that illustrated in Fig. 4. She has since remained snowy white, is in apparent good health, and lays occasionally. Photograph by James Machir. (Fig. 7.)

HERITABLE CHARACTERS OF MAIZE

VI. ZIGZAG CULMS[1]

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THE plant abnormality known as "zigzag culm" andd escribed in this paper, was first noted by Dr. R. A. Emerson in a number of F_4 cultures of a cross between Tom Thumb pop corn and a Missouri dent corn.

Some of the families in which zigzag culm was first found were breeding true for this peculiar type of stem so that it must have occurred in earlier generations without being detected. At first it was thought probable that this is another example of a mutation having occurred in a pedigree culture but the fact that zigzag plants have been found in the progenies of two different F_2 plants makes it much less likely. Dr. Emerson self-pollinated a number of plants and found that they breed true for the zigzag culm. He also found that when he crossed them with plants with normal culms the F_1 plants are apparently perfectly normal. Because of the many other problems that were demanding his attention Dr. Emerson asked the writer to investigate further the inheritance of this culm abnormality.

DESCRIPTION OF ZIGZAG CULM

In the early life of the plant it is not possible, at least so far as external appearances go, to identify the individuals which are destined to have zigzag culms. The character first becomes apparent about the time the plant comes into tassel. The first indication is what seems to be a flattening and broadening of the culm in the ear shoot region. This apparent flattening is due to the pulling away of the leaf sheathes from the culm. Within a remarkably short time the character is fully expressed and the plants appear as shown in the accompanying illustrations.

In Figs. 8, 9, and 10 are shown zigzag plants. It will be seen that these plants are more or less dwarfed, with the culm in the ear shoot region strongly zigzag and consequently pulled out of the leaf sheathes. Fig. 8 shows an entire plant, while in Figs. 9 and 10 only a part of the plant is shown. As these photographs were all taken from the same positions it is evident that the first plant is more dwarfed than the other two plants. The amount of dwarfing depends upon the number of internodes affected and the degree of the modification. The leaves are apparently normal except that the sheaths are pushed apart so that they do not clasp the internodes as they do in normal plants. A normal plant of the same pedigree culture is shown in Fig. 11.

In many zigzag plants the internodes affected are many times shorter than their leaf sheathes and often the sheath stands off at right angles to the internode, as shown in Figs. 9 and 10. The plant shown in Fig. 8 had a number of its internodes so much shortened that the long leaf sheathes overlapped to an unusual extent in the region affected. In Fig. 13 is shown the same plant with the leaves cut away so as to expose the stem. The leaves of the normal plant shown in Fig. 11 were likewise removed and the culm photographed as shown in Fig. 12. The internodes of the zigzag plant are not only shortened but much thickened. Apparently there is more rapid growth on the side of the internode above the leaf attachment which causes the internode to arch away from the leaf sheath. As alternate inter-

[1] Paper No. 84, Department of Plant Breeding, Cornell University, Ithaca, New York.
Photographs by I. W. Fisher, Department of Plant Breeding, Cornell University, Ithaca, New York.

A MATURE MAIZE PLANT HAVING A ZIGZAG CULM

Zigzag culm is an inherited plant abnormality which was at first thought to be another example of mutation, but later observations make this appear unlikely. The effect of zigzag culms, as one would expect, is to dwarf the plant in varying degrees depending on the number of internodes affected. This plant is extremely dwarfed because of the large number of internodes affected. The leaf sheathes overlap greatly in the ear shoot region because of the shortness of the internodes. (Fig. 8.)

ANOTHER PLANT WITH A ZIGZAG CULM

The zigzag character does not appear in the early life of the plant, and only becomes apparent about the time the plant comes into tassel. Then there is a pulling away of the leaf sheathes from the culm, but the leaves themselves are otherwise normal. This plant shows three internodes that are no longer clasped by the leaf sheathes. (Fig. 9.)

ZIGZAG CULM WITH UPPER AND LOWER INTERNODES APPARENTLY NORMAL

Usually only the internodes in the ear shoot region are affected. Note how the leaf sheathes stand off at right angles to the affected internodes. The plants are apt to break at these internodes, but otherwise they appear as vigorous under field conditions as normal plants. (Fig. 10.)

nodes have the leaves attached at opposite sides the result is a more or less zigzag stem.

Extracted recessives from crosses vary considerably in the expression of the zigzag character. In Figs. 14, 15, and 16 are shown such extracted recessives. The plants shown in Fig. 14 are quite distinctly zigzag and somewhat dwarfed. The short twist high on the stem of the second and third plants in Fig. 14 is another plant abnormality which will be described in another paper. So far as known at present it is inherited independently of zigzag culm. Other less extreme plants are shown in Fig. 15. Such plants can very easily be recognized when mature by stripping away the leaves in the ear shoot region. The plants shown in Fig. 16 were selected to show how closely some zigzag plants approach normal plants in appearance. Such plants are not perceptibly dwarfed as the internodes are only a very little or not at all shortened, even in the ear shoot region. After some experience such plants can easily be identified after removing the leaves. It will be noticed that in each of the plants shown in Fig. 16 a number of the internodes are arched away from the point of leaf attachment. Comparison of these culms with the culm of a normal plant as shown in Fig. 12 will make this clear.

INHERITANCE OF ZIGZAG CULM

Mention has already been made that zigzag culm was found by Dr. Emerson to be a recessive character. The writer also made many outcrosses with normal plants and in every case the F_1 plants were apparently normal. Several F_2 progenies were grown which gave a total of 343 normal to 23 zigzag plants. This is a very wide departure from a 3:1 relation which should obtain if zigzag culm is a simple mendelian recessive. There is, however, a deviation of only 0.1 ± 3.1 plants from a 15:1 relation expected when two factors are concerned in the expression of a character. This is an exceedingly close fit. In taking the notes each plant was entirely defoliated and its culm was carefully examined. In spite of the close agree-

A MAIZE PLANT WITH NORMAL CULM

SAME PLANT WITH LEAVES REMOVED

Compare these normal culms with the zigzag culms in the illustrations which follow. (Figs. 11 and 12.)

ment to the two factor hypothesis the questions arose as to whether the deficiency in zigzag plants might not be due either to my inability to identify some of them or to a high death rate because of inherent weakness. So far as I have observed zigzag plants are as vigorous under field conditions as normal plants except that they are more apt to break in the internodes that are no longer clasped by the leaf sheathes.

A number of F_1 plants were back-crossed with the zigzag parental type, and there resulted 373 normals and 104 zigzag plants, a deviation of 134.5 ± 7.4 from the equality expected when parents differ in a single pair of factors, but a deviation of only 15.25 ± 6.38 from a 3:1 ratio expected when parents differ in two pairs of factors.

These data indicate that zigzag culm comes into expression only when at least two factors are recessive, and is another case of plural genes. Crucial tests of the hypothesis are yet to be made.

SAME PLANT AS SHOWN IN FIG. 8 WITH LEAF SHEATHES CUT AWAY

It will be noted that the internodes in the ear shoot region are much shortened, thickened, and arched away from the side of leaf attachment. (Fig. 13.)

ZIGZAG CULMS OF THE MORE EXTREME TYPE

Comparison of these culms with the normal one shown in Figs. 11 and 12, indicates plainly that the internodes of a zigzag plant are not only shortened but also considerably thickened, indicating a more rapid growth on the side of the internode affected. These are extracted recessives from crosses and, together with those in Figures 8 and 9, show that there is a considerable variation in the expression of the zigzag character. The short twist high on the second and third plants is another abnormality not of the zigzag character. (Fig. 14.)

ZIGZAG CULMS WITH FEW INTERNODES AFFECTED

These exhibit a much less extreme zigzag character than those in the previous illustration. Such plants are nearly as tall as their normal sibs but may be easily identified, especially by stripping away the leaves in the ear shoot region. (Fig. 15.)

ZIGZAG CULMS APPROACHING NORMAL CULMS IN APPEARANCE

These plants were selected to show how closely some zigzag plants approach normal plants in appearance. Their dwarfness is not very noticeable. Note the number of internodes that are arched away from the point of leaf attachment. Upon comparison with the normal culm shown in Fig. 12 the zigzag character which is here less distinctly expressed becomes evident. (Fig. 16.)

BETTER AMERICAN FAMILIES—IV

A Brief Story of Several American Families Which Have Contributed Noteworthy Leaders in the Development of Our National Life[1]

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MANY of us, as we look into the face of America today are wondering what this face will be like a few generations hence. Such a confusion of prophecies strikes our ears, prophecies in which the customary optimistic note is discouragingly lacking! In the turmoil that has succeeded the war, ugly elements have come to the surface of our national life, menacing possibilities which never before were suspected of existing here.

Earnest people are everywhere asking: "Is this, our boasted many-sided civilization, to prove a scandalous failure in the hour of its greatest success? How shall we bring harmony into warring ideals and unity into the divergent purposes of our multitudinous population? How are we to so solidify our national life as to present an immovable bulwark to a foe that continues to threaten now within as well as without our gates? For we know that on our success in conferring a genuine naturalization on the alien, depends our success in the experiment of making democracy safe for ourselves and the world.

WHAT FORCES ARE SHAPING THE NATION?

The half century that succeeded the Civil War marked a fabulous growth in national wealth and power; it witnessed an astounding march of settlement till a vast continent was subdued, and an extension of industry, through a rule of coal-barons and steel-kings over millions of aliens thrust full-grown into the fabric of our national life. This has meant, largely, progress by masses of mechanical power, the furnace, steam and electricity. While the workers show capacity to manage these forces, the function of internal government has become the task of controlling these men, many of whom have remained as remote from a truly American spirit as though they had never touched our shores. If our present time of "taking stock" brings us any vision of the forces that have made America, and the processes that should shape a nation, if it ever so slightly directs our wills to a conscious shaping of these processes, it will have been worth all the agonies it is costing us.

It is perhaps not generally known that this nation passed through a similar period of turbulence in the years following the Revolution, particularly in the period of French Terrorism. The Constitution was adopted and the present government put into operation at a time when there was not a grammar, a geography or a history of any kind in the schools, and when a teacher who could compute interest was considered "great in figures." In thrifty New England, idle men loafed on street corners while women and children went in rags; the outposts of settlement were largely held by a nomad race, part farmer, but mostly hunter, who housed there numerous broods in filthy cabins, and held as the highest ideal, complete unrestraint from all social and governmental control. Franklin declared the press of the day was supported by human depravity, and Knox wrote Washington that in Massachusetts, those who opposed the Constitution acted "from deadly principle levelled

[1]This is the fourth in a series of five articles on this subject by the same author, the former papers having appeared respectively in the January, February and March 1919 numbers of the JOURNAL OF HEREDITY.—Editor.

at the existence of all government whatsoever."

Yet at this time there were parts of the country where order and sobriety were the rule. New England, in its more thickly settled portions, was thrifty and industrious, New York and Pennsylvania had their prosperous, well-cultivated valleys, and farther south, worthy elements of the population gradually gained ascendency over the drinking law-denouncing settlers. In the pioneers who took up the farms abandoned by the first haters of civilization, we find representatives of our best colonial and old-world stock, who speedily displaced the improvidence and dissipation by piety, enterprise and thrift; also, they founded colleges and academies—off-shoots of the half-dozen which had held their own through a century in the East, where educated and devout men carried a lamp of learning and an inspiration to right living.

GENETIC FACTORS IN AMERICANIZATION

In previous papers we have sought a genetic interpretation of the process of Americanization. We have found its essence to consist in an ever greater approximation to standards and ideals set by certain regnant personalities. The completeness of the approximation is of necessity dependent on the native bent of the lesser families, thus having its foundation in the genetic constitution of the strains to which these families belong. These strains have not necessarily been derived from colonial stock. In the hordes of immigrants which the steerage disgorged on our shores annually through a dozen decades, there have been those as surely predestined to become "good Americans" as ever were fore-ordained to an apostolic succession. There have been Italians and Germans, Scandinavians, Jews and Serbians born in the American spirit and unquestioningly giving allegiance to the best in American life. Added to these were others, less resolutely American, but who might nevertheless have become so by contact with the best instead of the worst in our institutions.

We have found, then, as a necessary fundamental in Americanization, certain genetic factors conditioned through right marriages which insure the basis for the educative process. We have seen how social selection has brought together the fittest representatives of mixed strains through their migrations for a common purpose, and by their mating produced endowment above the average. In similar fashion the less able, left behind in the old environment have all too often, mated and given rise to a variety of defective and degenerate conditions.

In certain families which have been intensively studied, this process is seen extending over six and seven generations, resulting in well-defined socially fit and socially unfit lines, and we are justified in holding that almost any family whose history is scrutinized for a number of generations will show a like breaking up into lines of varying social efficiency.

While the need of cutting off defective and degenerate lines is becoming widely recognized and is being met by legislative enactment, there is as yet little organized effort to direct the evolution of lines among our mediate and superior classes. In this vaster attempt, the enlightened individual conscience must be appealed to. The heightening of our sense of social responsibility in marriage should be one of the beneficient effects of the world-war. The knowledge that a faulty heritage due to unwise matings played a major rôle in the production of the war-neuroses, thereby rendering the individual a liability rather than an asset in time of national stress, should bring home, as never before, individual responsibility to the state in the choice of marriage mates. Further, to see how a superior heritage due to fortunate alliances has meant a finer endowment, which in the favoring environment of the better lines has flowered into various forms of pre-eminence, should give an incentive to increase social worth

by this means as by the more universally recognized means of education.

INHERITANCE OF ABILITIES

Concluding this article is a genetic classification of American strains. The families already considered in papers II and III of this series belong to classes having low and mediate social worth. It is now proposed to consider certain American families of superior and superlative worth and the part which inheritance played in making such worth possible.

If we take up the genealogy of any family whose name suggests eminence in some lines, we are struck by the recurrence in successive generations of similar abilities, or at least of occupations which would imply similar abilities. While the majority of persons described are more or less obscure, still we are apt to find here and there what might be termed concentrations of various types of ability. Thus we find one line remaining tillers of the soil, another given to merchandizing, while still another shows several examples of artistic gifts. In the latter case the artistic ability may in certain branches "shade off" into a well-marked artisan group. Again, we find a decided altruistic bent for several generations, this evincing itself in the selection of the ministry as a life-work and the preference for the teaching profession. Often the occurrence of a name standing for pre-eminence of a particular kind is heralded by a number of lesser lights whose tastes and occupations give evidence of similarity of endowment. Many of the most interesting cases are where a gift which remained the avocation or pastime in a father becomes in the son the supreme endowment.

We have a fine example of this in the late E. A. Abbey. Asked how he got his first great commission, he gravely replied: "Through my grandfather." To the further question: "You are going to decorate the Capitol of Pennsylvania; did your grandfather get you that commission too?" he said: "If I do the work, he will be the cause." This grandfather was a wealthy merchant and type-founder of Philadelphia, whose happiest days were spent at his easel. It is said his only brother had much artistic talent, though he was an artisan, a painter by trade, with a son who was likewise a painter. This merchant's cousins were artisans, too, with some artistic gifts—one, a jeweler, was also a fine musician and intelligent florist, with a son who became a well-known dramatic manager. Abbey's father was, like his father, a merchant, though inheriting the gift for painting, while his brother was an artist and followed the profession of law.

The Abbeys are described as a race of soldiers, path-finders and pioneer settlers. From their first homes in Connecticut, they pushed up the Connecticut Valley, turning westward with the tide of exploration and settlement through New York, then into Ohio and Michigan and eventually across the continent. Nor were their most illustrious examples of pioneering found in the West. Cleveland Abbe possessed pioneering instinct in abundance with daring imagination, courage and enthusiastic urge in pursuit of a new idea. These abilities conceived and carried to success the multitudinous daily observations on which depend our National Weather Service, which has no parallel in similar undertakings. His brother was known for his original work in the application of radium to medicine, a line which is also followed by his son, while another son is a geographer continuing in the same type of work as his father.

Of the inheritance of mechanical and inventive skill, the Fairbanks and the Pomeroy families have long been known as splendid examples. James Fairbanks married Phoebe Paddock whose two brothers were iron-workers. Erastus Fairbanks, their son, manufactured stoves and plows, while Thaddeus, his brother, invented the platform scales. Erastus married Lois Crosman and had two sons, the elder with much inventive ability and love of natural

history, the younger with a genius for administration, who became Governor of Vermont. Henry, who was a son of Thaddeus, went into the ministry but his love of invention later drew him into manufacturing.

Executive ability, the power of doing things, is also a salient trait in the Pomeroy family. Eltweed, the founder of the family in America was given a grant of 1,000 acres of land by the province of Massachusetts on condition of his establishing his business as gunsmith within its bounds. In each of the seven generations that succeeded him, there has been at least one following the same trade. In this family, the power of doing things easily is frequently carried so far as to exclude the tendency to think about them. The typical Pomeroy is said not to be a good teacher, and the reason as given is that they see through a process so quickly they lose sight of the intermediate steps and thus are unable to explain them to another. If we study their genealogy carefully, we find interesting instances of the coming of this power of abstraction and elucidation in later generations through their marriage into strains such as the Strongs and the Dwights which have this ability in abundance.

Another instance of the inheritance of ability in construction is in the Herreshoff family, designers and builders of the swiftest sailing boats in the world. The first representative in this country was Charles F. Herreshoff who, though an accomplished artist, had little practical business ability. He married Sarah Brown, proficient in music and mathematics, whose family had amassed fortunes in foreign and domestic trade, carrying their goods in ships of their own manufacture. Their son founded the Herreshoff Manufacturing Company and was associated with his three sons, all experts in naval architecture. In none of these examples can we lay the signal success to tradition or merely opportunity, for plenty of their associates have had similar opportunities without once feeling the impulse toward construction of this type.

The history of America gives many illustrations of signal ability in finance extending through three or more generations. We have but to think of the names of Astor, Vanderbilt, Morgan and Rockefeller, Drexel and Palmer, all of whom stand for vast accumulated wealth. It is interesting to reflect what the scions of these houses would have been had they lived in an age which permitted a different type of exploitation, the age of Raleigh and Frobisher. Most of them piled up their riches by conquest of virgin resources, though there are not lacking instances where the chief characteristic was the will and the power to over-ride all competitors. For the most part these American projectors belong to lines of their respective families which show great force and energy, an instinct for contrivance, acquisitiveness, and a spirit of emulation which would brook no opposition to the fulfillment of its schemes. However our captains of industry are not all of the same type, just as they have sprung from stocks whose leading traits have not been by any manner the same. With determination, vitality, and the ability to evaluate correctly situations of all kinds in common, we find in one type love of adventure and exploration, a passion for taking great risks, the traits of the "dead game sport," while in another type, painstaking calculation, careful policy and great economy are the salient characters.

The latter qualities were exemplified to a marked degree in John Jacob Astor, the founder of a line of our most noted financiers. In the sordid confines of a butcher's home in the remote village of Waldorf, we find his childish imagination aflame with legends of marching hosts of Romans, taking their triumphant way along the military road on which the hamlet lay. Later, under the inspiration of letters from America, the vision took the form of possible conquest for himself, so that he spurned the father's trade, and at sixteen, made his way to London and there by arduous unskilled labor earned his passage to America. Here, he was first a peddler of cakes, but with

his first small investment in furs, undertook the hazardous foot and canoe journeys which gave him that knowledge of strategic positions for forts and trading posts which made possible the development of his colossal trading interests. At every step of the way he showed "a persevering industry, a rigid economy and strict integrity. To these were added an inspiring spirit that always looked upward; a genius bold, fertile and expansive; a sagacity, quick to grasp and convert every circumstance to its advantage and a singular and unwavering confidence of signal success." Like energy, optimism and practical sense are said to have distinguished his mother, and she endowed similarly two other sons who signally prospered. John Jacob was the first of a line of which William B., his son, William and John Jacob 3rd, grandsons, and John Jacob 4th and William Waldorf are the most noted.

THE LEAD OF GREAT PERSONALITIES

The study then of these family histories brings into relief lines noted for ability in art, business, mechanical construction and scientific investigation, with the frequent occurrence of members who have achieved renown in the various lines. These leaders pos-

GENETIC CLASSIFICATION OF AMERICAN STRAINS

Aristogenic, Through segregation in superior stocks, producing trait-complexes of high excellence.

I. Superlative worth.
   1. Jurisprudence—eg: Kent, Story, Marshall
   2. Statecraft—eg: Adams, Lowell, Livingston
   3. Metaphysics—eg: Edwards, Woolsey
   4. Education—eg: Mann, Dwight, Edwards
   5. Social Reform—eg: Beecher, Abbott
   6. Religion—eg: Ballou, Channing
   7. Military Leadership—eg: Washington, Lee
   8. Oratory—eg: Choate, Webster
   9. Literary Expression—eg: Prescott, Irving
   10. Histrionic Art—eg: Booth, Sothern
   11. Poetry—eg: Bryant, Longfellow
   12. Graphic Arts—eg: Abbey, Inman
   13. Music—eg: Hutchinson, Buck
   14. Natural Science—eg: Agassiz, Baird
   15. Mathematical Sciences—eg: Newcomb, Pickering
   16. Invention—eg: Morse, Bell
   17. Politics—eg: Hamilton, Randolph
   18. Pioneer Life—eg: Boone, Sinclair
   19. Engineering—eg: Pomeroy, Herreshoff
   20. Exploration—eg: Peary, Greeley
   21. Finance—eg: Astor, Girard, Morgan

II. Superior worth.
   Special skill, intelligence, enterprise, etc.
   Names occurring in "Who's Who in America."

Eugenic, Through segregation, contributing to classes of superior as well as those of inferior worth.

III. Mediate social worth.
   Showing a great range of aptitudes and abilities in moderate degree.
   The so-called middle class, making up the run of mechanics, small farmers and trades-people, clerks, operators, general laborers, etc.

Cacogenic, Through segregation, producing recessive trait-complexes.

IV. Low social worth.
   Marked psychical or temperamental defects.
   1. Feeble-minded
   2. Pauperous
   3. Neuropathic
   4. Criminalistic
   5. Insane
   6. Sex Perverts
   7. Crippled
   8. Psychopathic

   The "Jukes," "Kallikaks," "Ishmaelites."

This classification is intended to be mainly suggestive. The classes are not sharply delimited from one another, and the examples given for superlative worth are not necessarily of uniform value. They are such as would occur to the reader and serve to illustrate how certain lines of a given family name may come to bear a more or less distinctive character, depending primarily on fortunate trait-complexes and secondarily on the environal influence known under the term "social heritage."

sessed in marked degree the daring pioneer spirit, which, exemplified to a lesser extent in so many of our countrymen, has made the epic of conquest of the continent.

What a story it has been, of fortitude and sacrifice and of courage surpassing that of a soldier! We should fitly celebrate this struggle with the wilderness, with scorching heat and biting cold, with flood and drought and fire. We should be grateful for the planting here of those families fitted to cope with adverse circumstance and turn mischance to victory, and for the best from many racial strains who followed acceptably where the greater personalities led. This is the story of "Americanization" on its material side, though to it have been brought many of the finest qualities with which man is endowed. From one point of view, it is the story of chosen germ-plasms, that should lead every one who can even remotely appreciate it, to resolve that so far as possible his family shall be one of the chosen to lead further on the path of progress.

HEREDITARY TRADES

THE agricultural population of Italy furnishes a rather interesting example of the preservation of tribal occupational distinctions. For centuries the people of the Burino, Ciocare, Rieti, Abruzzi, or Ortanesi have followed their individual vocations of reapers, diggers, sowers, vine-trimmers, etc., in the fever-swept marshes of the Roman Campagna, and the names of these families who worked in the fertile though deadly plains have been adapted, in the common parlance of the agricultural world of Italy, to mean any follower of that trade. So identified with the art of seed-planting are, for example, the Rieti, that sowers throughout Italy are called "Rieti," regardless of their origin, and the threshers are known popularly as "Ciocare."

The really remarkable fact concerning the fidelity of each of these races to its vocation is that this adherence to tradition continues despite the unhealthy character of the region in which they have so long operated. They suffer no delusion as to the danger of working in the marshes, but the fertility of the soil, from which may be garnered three crops yearly—grain, grapes, and charcoal—has kept generation after generation following in the footsteps of the preceding one. Few breaks from the lineal tradition have taken place. The terrible death-rate in the community has orphaned hundreds of children, and the orphanages with industrial schools and agricultural colonies, which the Junior Red Cross of America has founded at Piperno and Sezze, are filled largely with these children, still known by their racial cognomen, as "children of the reapers, vine-trimmers, etc."

These agricultural workers do not remain in the region throughout the year. As the season fitted to the occupation of each comes around, each community gathers together its goods and implements and migrates to the malarial marshes of the coastal plain. First to come in the spring are the Abruzzi, tillers of the soil from Aquila in the mountains above Rome, next follow the Rieti, sowers from the Sabine mountains, the reapers of the Burino race from the Lapini hills above the marshes, and then the threshers who still wear the heavy sandal-like shoes which aid their leathern flails in threshing out the grain.

Interesting and picturesque though these farmers may be from the viewpoint of heredity, they do not satisfy the laws of modern hygiene in their choice of territory. Many of the children of these races are now being taught trades in the Piperno and Sezze schools, which will doubtless take them away from the unhealthy plains, and the fate of the remainder depends largely upon the results of an Italian engineering project, now on foot, which should succeed in making of the plague-ridden marshes a far more healthful neighborhood. A photograph of Italian orphans pruning vines is shown on the following page.

ITALIAN ORPHANS PRUNING VINES ACCORDING TO THE METHODS OF THEIR FOREFATHERS

These boys from one of the agricultural colonies directed by the Junior Red Cross in Italy are trimming the vines according to the rules followed by former generations. They are twining the young vines over an elaborate scaffolding of twigs on the ash and poplar trees until the vines can climb by themselves. Photograph from the American Red Cross. (Fig. 17.)

INHERITANCE IN CROSSES OF DAIRY AND BEEF BREEDS OF CATTLE

III. Transmission of Butter-Fat Percentage to the First Generation[1]

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THE inheritance of *milk yield* in the first generation crosses of dairy and beef breeds of cattle was treated in the second paper of this series.[2] The inheritance of butterfat percentage for the same crosses will be analyzed here.

Butter-fat percentage has been shown to have a considerable variation with age in the Ayrshire breed, some relation to age in the Jersey and Guernsey breeds and no significant relation to age in the Holstein-Friesian breed. These relations necessitate the application of age correction factors to the Jersey, Guernsey and Ayrshire records for butter-fat percentage to make these records comparable. Without any previous knowledge as to how age will effect the butter-fat percentage of the crosses between these breeds, it has been thought advisable to correct the crossbred records with the same set of correction factors which were used for the Jersey and Guernsey. When a butter-fat percentage record is mentioned in any subsequent section of this paper it is to be understood that it is an age corrected record.

HOW THE RECORDS ARE OBTAINED

The butter-fat percentage record for any given crossbred cow or her dam is obtained by taking the mean butter-fat percentage of the different lactations during the cow's life at the same corresponding month of lactation. The butter-fat percentage of the sires, Taurus Creamelle Hengerveld and Lakeland's Poet, are the mean of the butter-fat percentage of their daughters other than crossbred daughters. The record of Kayan, where no pure bred daughters are available, is obtained by averaging the records of the Aberdeen-Angus cows in the herd. The record for Delva's University DeKol is the record of Taurus Creamelle Hengerveld. The records of the last two sires are subject to the same criticisms cited in the second paper of the series.

The details of the number of lactations which make up the record of the given cow are given in the second paper of this series and need not be repeated here.

BUTTER-FAT PERCENTAGES

The first graph in Figure 24 shows the monthly butter-fat percentage of Crossbred No. 1, her pure bred Holstein-Friesian dam, Pauline Posch and the potential record of her Jersey sire, Lakeland's Poet. Photographs showing Crossbred No. 1 and her parents are shown in the previous paper of this series. The solid line (————) represents the crossbred's butter-fat percentage, the dotted line(··········) the butter-fat percentage of her dam and the dot and dash line (·—·—·—·) the potential butter-fat percentage of her sire. The butter-fat percentage of this crossbred is clearly intermediate between that of her high butter-fat test sire and her low butter-fat percentage dam. The eight months' butter-fat percentage for Crossbred No. 1 was 3.899. The butter-fat percentage for her Holstein-Friesian dam was 2.758 and for her Jersey sire was 4.705. The crossbred cow was consequently 0.806 per cent less than her Jersey parent and 1.141 per cent more than her low testing Holstein-Friesian parent. The

[1] Papers from the Biological Laboratory of the Maine Agricultural Experiment Station, No. 136.

[2] Gowen, John W., 1920. Inheritance in Crosses of Dairy and Beef Breeds of Cattle. II. On the Transmission of Milk Yield to the First Generation. JOURNAL OF HEREDITY, Vol. XI (1920), No. 7, pp. 300-316.

Crossbred No. 1 is consequently nearer the high test parent than the low test parent. It is perhaps fair in this connection to say that the butter-fat percentage of Pauline Posch is low even for the Holstein-Friesian breed, the mean for the breed being nearly .5 per cent higher than her average.

Crossbred No. 2 has her butter-fat percentage shown in the second graph in Figure 24. She is the result of a cross of the Holstein-Friesian sire, Delva's University De Kol, to the Guernsey cow, Canada's Creusa. The photograph of Crossbred No. 2 is shown in Fig. 18. The characteristics of the Holstein-Friesian parent are seen in the rump, the size of body and the profile of the nose.

The butter-fat percentage of this crossbred clearly resembles that of her low testing Holstein-Friesian parent. The average butter-fat percentage of Crossbred No. 2 for the eight months' period was 3.241. The average butter-fat percentage for her Guernsey dam, Canada's Creusa, was 3.961,[3] and for the potential butter-fat test of her Holstein-Friesian sire, Delva's University DeKol was 3.399. The butter-fat percentage of the crossbred cow is consequently slightly less than that for either parent. The difference from her Guernsey parent is 0.720 per cent and from her Holstein-Friesian parent 0.158 per cent. Crossbred No. 2 resembles the low butter-fat percentage 4.5 times as closely as she does the high butter-fat percentage.

The third graph in Figure 24 represents the butter-fat percentage of the Crossbred No. 11 and that of her pure bred Jersey sire, Lakeland's Poet, and her pure bred Holstein-Friesian dam, Delva Johanna DeKol.

Photographs of the animals used in this mating are shown in Figs. 19, 20 and 21. The dark underline and fair Jersey conformation of Lakeland's Poet are clearly seen. Delva Johanna DeKol shows the typical conformation of her body and udder. Crossbred No. 11 has an appearance of size in the fore quarters and a lack of these qualities in the hind quarters which is due largely to the position in which she is standing.

While the butter-fat percentage of Crossbred No. 11 is intermediate between that of her high testing and her low testing parents throughout the entire lactation, it is equally clear that the butter-fat percentage of the cross is much nearer that of her low testing parent than it is to that of the high testing parent. The mean butter-fat percentage of Crossbred No. 11 for the eight months' period is 3.403, that for the Holstein-Friesian dam 3.224, the potential butter-fat percentage for the Jersey sire is 4.705. The difference between the low testing dam and the crossbred cow is consequently 0.179. The difference between the crossbred and her high testing sire is 1.302, or Crossbred No. 11 resembles the butter-fat percentage of the low testing parent 7.3 times as closely as she does the butter-fat percentage of the high testing parent.

The butter-fat percentage of Crossbred No. 12 and her Guernsey dam, College Gem, together with the potential butter-fat percentage of her Holstein-Friesian sire is shown in the fourth graph of Figure. 24. Photographs of the animals composing this mating are shown in the previous paper of this series. The butter-fat percentage of College Gem, the mother to this crossbred cow, and that of Creusa's Lady, the dam of Crossbred No. 29, is considerably higher than that of other animals used in these crosses. A study of the butter-fat percentage of the breed to which these cows belong and also of the Jersey breed makes it appear quite possible that there are at least two levels of butter-fat percentage, speaking from the inheritance viewpoint, within these breeds. Should such prove to be the case the results of the crosses including these relatively high butter-fat testers might produce a different result than those including the lower testing cows.

[3] The butter-fat percentage for Canada's Creusa is clearly very low for a Guernsey cow. In the advanced registry of this breed the average year test is 4.9 per cent of butter-fat.

CROSSBRED NO. 2, HOLSTEIN-FRIESIAN X GUERNSEY CROSS

In size of body and profile of nose this crossbred shows the characteristics of her Holstein-Friesian sire. Her percentage of butter fat production is slightly lower than that of either parent. See the second graph in Fig. 24. (Fig. 18.)

The graph for the butter-fat percentage of Crossbred No. 12 shows it to be intermediate between the high testing and the low testing parents. The low testing parent is more closely followed by the Crossbred for each monthly test. The eight months butter-fat percentage of Crossbred No. 12 is 3.885 per cent, the Guernsey dam has a butter-fat percentage of 5.476 per cent and the Holstein-Friesian sire's potential butter-fat percentage is 3.399 per cent. The crossbred cow's butter-fat per cent is 1.591 per cent less than her high testing dam and 0.486 per cent more than her low testing parent, or the crossbred is 3.3 times as near the low butter-fat percentage as she is the high butter-fat percentage.

BUTTER-FAT PERCENTAGES OF SIMILAR MATINGS

It is of some interest to compare the butter-fat percentage of the similar mating for Crossbred No. 2 with the results for this mating of Crossbred No. 12. The Guernsey dam in the first case had a very low butter-fat percentage 3.961 whereas the Guernsey dam for number 12 had a butter-fat percentage which is above the average for the breed. The butter-fat percentage of the Crossbred in the first case was low, lower even than the Holstein-Friesian parent. The butter-fat percentage of the Crossbred in the second case was higher, almost equaling that of the low testing Guernsey dam of the first cross.

The Aberdeen-Angus breed has a butter-fat percentage about the same as that of the lower testing Jerseys and Guernseys of these experiments, that is a mean of about 4.4 per cent with considerable range on either side of this point. The crosses made between these lower testing Jerseys and Guernseys with the Aberdeen-Angus are con-

LAKELAND'S POET, PUREBRED JERSEY SIRE OF CROSSBRED NO. 11

Note the dark underline and fair Jersey conformation. Lakeland's Poet is also the sire of Crossbred No. 15 shown in Fig. 23. (Fig. 19.)

DELVA JOHANNA DE KOL, PUREBRED HOLSTEIN-FRIESIAN DAM OF CROSSBRED NO. 11

The typical Holstein-Friesian conformation of body and udder is clearly represented. (Fig. 20.)

CROSSBRED COW NO. 11

This cow is the product of the Jersey and Holstein-Friesian parents shown on the opposite page. The appearance of size in the fore quarters and lack of it in the hind quarters is largely due to the position in which she is standing. The size and shape of her udder, conformation and other features, are quite well represented. The third graph in Fig. 24 shows the butter-fat percentage of this crossbred to be almost intermediate between her high-testing and low-testing parents. (Fig. 21.)

sequently of little interest. They are included in the graphs for sake of completeness.

The fifth graph in Figure 24 shows the butter-fat percentage for Crossbred No. 15 and her Aberdeen-Angus dam, Hearthbloom, and Jersey sire, Lakeland's Poet. Very little difference is seen in the butter-fat percentages of these animals. The eight months butter-fat percentage for Crossbred No. 15 is 4.404; for her dam Hearthbloom 4.404 and for her Jersey sire 4.705. Crossbred No. 15 agrees exactly with her lower testing parent and is .301 per cent less than the higher testing parent.

Figures 22 and 23 represent Crossbred No. 15 and her Aberdeen-Angus dam. The heavy, blocky, well filled conformation of Hearthbloom is typical of the Aberdeen-Angus breed. There are many points of resemblance between Crossbred No. 15 and her dam.

The sixth graph for Figure 24 shows the butter-fat percentage for Crossbred No. 16, her Jersey dam College Ruth and her Aberdeen-Angus sire, Kayan. The photographs of the animals composing these matings are shown in the previous paper of this series. Little difference between the butter-fat percentages for the three animals is noted. For the first eight months of lactation the butter-fat percentage of Crossbred No. 16 is 4.894, for College Ruth 4.849 and for Kayan 4.386. The crossbred

cow is consequently 0.045 higher in butter-fat percentage than her dam and 0.508 per cent higher than her sire.

The top graph in Figure 25 represents the butter-fat percentage of Crossbred No. 22, her Guernsey dam, College Creusa and her Aberdeen-Angus sire, Kayan. As explained in the previous paper, the graphs in Figure 25 are less reliable than those of Figure 24, since they are composed of a less number of lactations for the crossbred cows. Little difference in the butter-fat percentages of these three animals are shown by the graphs. The eight months butter-fat percentage of Crossbred No. 22 was 4.526, the butter-fat percentage of her Guernsey dam 4.825 and of her Aberdeen-Angus sire 4.386. Crossbred No. 22 is 0.299 per cent of butter-fat less than her dam and 0.140 per cent more than her sire.

The butter-fat percentages of Crossbred No. 26 and her parents, Creusa of Orono 3d, Guernsey dam, and Kayan, Aberdeen-Angus sire, are shown in the second graph in Figure 25. Little difference in the monthly butter-fat percentage of the three animals is seen in the graphs. The mean eight months butter-fat percentage of Crossbred No. 26 is 4.100, that for the Guernsey dam 4.679 and for the Aberdeen-Angus sire 4.386. Crossbred No. 26 has 0.579 per cent of butter-fat less than her dam and 0.286 per cent less than her sire's potential butter-fat percentage.

The butter-fat percentage of Crossbred No. 27 is seen to vary irregularly over that of her two parents in the third graph of Figure 25. Crossbred No. 27 is the result of a cross between Orono Madge, Aberdeen-Angus cow, and Lakeland's Poet, Jersey bull. The average butter-fat percentage of Crossbred No. 27 is 4.474, of her Aberdeen-Angus dam's 4.640, and of her Jersey sire 4.705. Crossbred No. 27 was 0.166 per cent of butter-fat less than her dam and 0.231 per cent of butter-fat less than her sire.

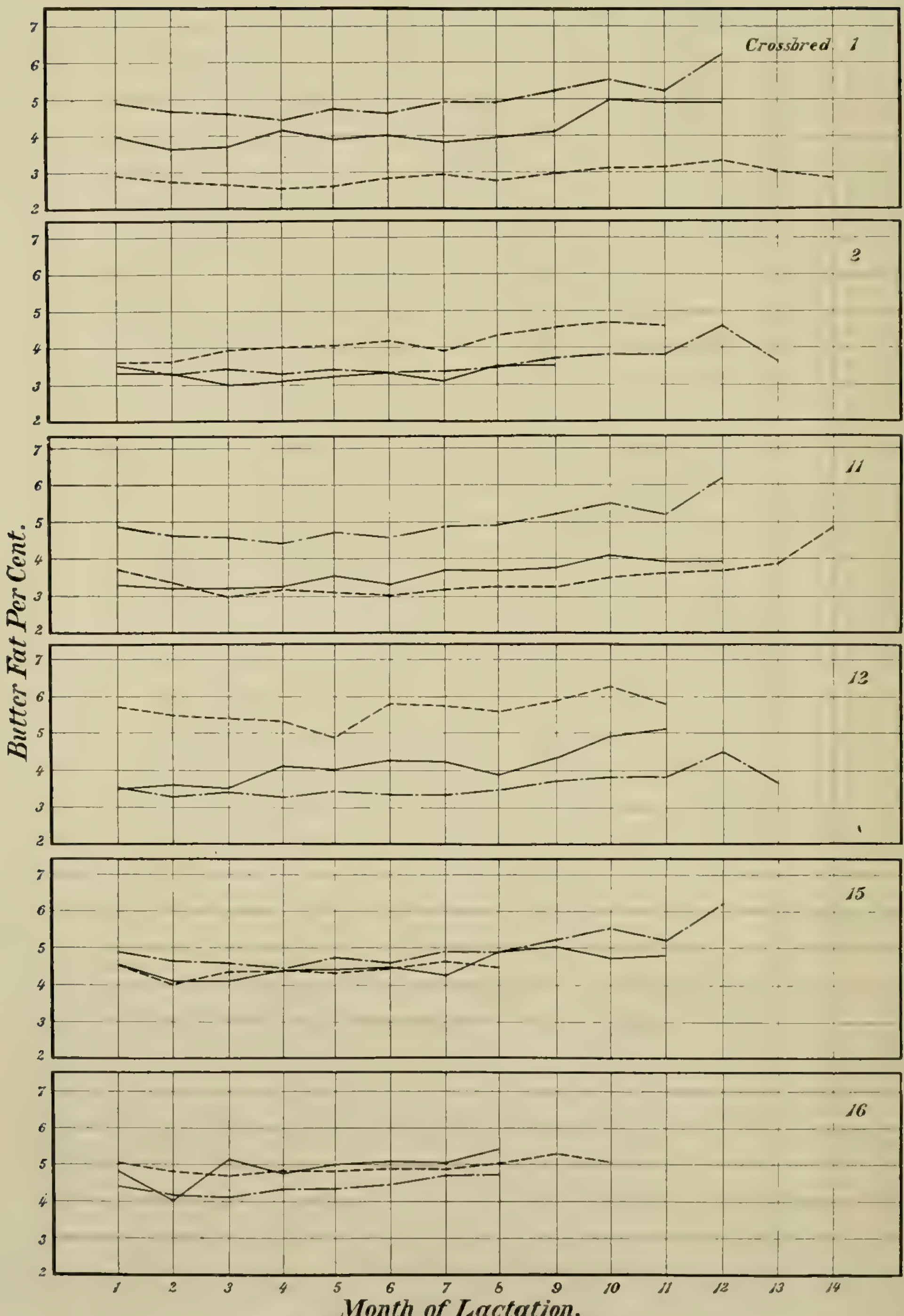
While Crossbred No. 29 is the result of a cross between Creusa's Lady, Guernsey dam and Kayan, Aberdeen-Angus sire, she is of some interest, since her dam, Creusa's Lady, is one of the higher butter-fat testing Guernsey cows. The fourth graph in Figure 25 shows the monthly butter-fat percentage for this mating. For the first month the butter-fat percentage of the crossbred is higher than that of either parent. After this time her butter-fat percentage follows the butter-fat percentage of the relatively lower testing Aberdeen-Angus parent. The mean butter-fat percentage for the eight months period is 4.534 per cent for the crossbred cow, 5.346 for her pure bred dam and 4.386 per cent for her sire. The crossbred is 0.812 per cent less in her butter-fat test than her dam and 0.148 per cent more than her sire. The crossbred cow resembles her low testing parent 5.5 times as closely as she does her high testing parent.

The average butter-fat percentage of the Ayrshire breed is 3.68 per cent. This is about 1.0 per cent below the butter-fat percentage of the Aberdeen-Angus contained in this herd, and only 0.4 per cent above the average of the Holstein-Friesian breed. Crossbred No. 37 is the result of a cross between the Ayrshire cow, Dot Alaska and the Aberdeen-Angus sire, Kayan. The fifth graph of Figure 25 gives the butter-fat percentage of Crossbred No. 37 and her parents. The crossbred's record is for only one complete lactation and one half of the next. Considerable variation would consequently be expected for this record. In the fifth month of lactation the butter-fat percentage of Crossbred No. 37 is slightly higher than that for the high testing parent, Kayan. Other than this record the butter-fat percentage of the crossbred closely approximates that for the lower testing parent, Dot Alaska. The eight months butter-fat percentage for Crossbred No. 37 was 3.861 per cent, for Dot Alaska was 3.661 per cent and for Kayan 4.386 per cent. Crossbred No. 37 is 0.200 per cent more in her butter-fat percentage than that of her dam, and 0.525 per cent less than her Aberdeen-Angus sire or the ratio is 1 to 2.6.

The last graph in Figure 25 is that for Crossbred No. 44. Crossbred No. 44

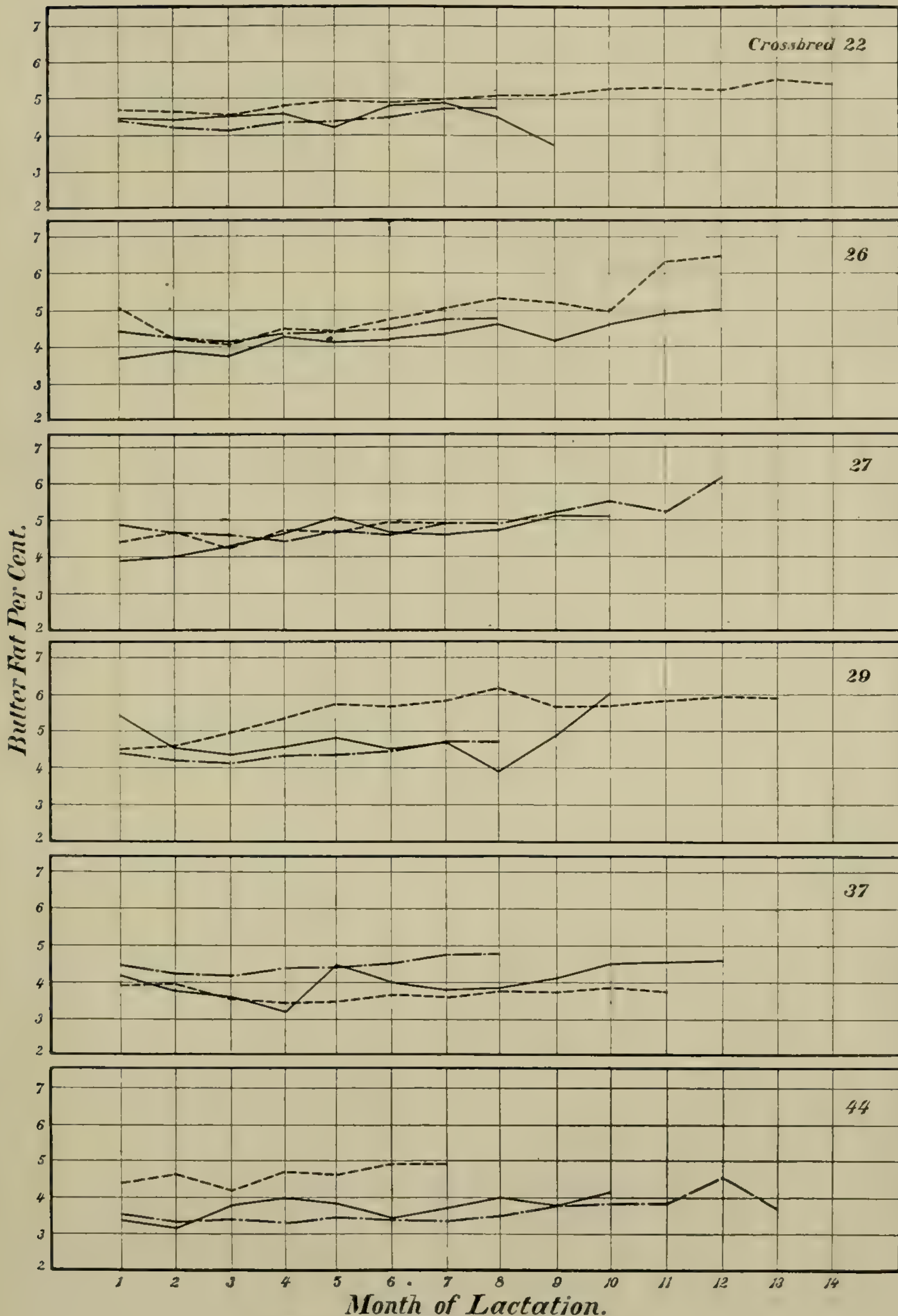
HEARTHBLOOM, ABERDEEN-ANGUS PARENT OF CROSSBRED NO. 15
The heavy, blocky, well-filled conformation of this cow is typical of her breed. (Fig. 22.)

CROSSBRED COW NO. 15
There are many points of resemblance between this crossbred and her purebred Aberdeen-Angus mother, the polled head, heavy fore quarters and black coat being the main features. The 5th graph in Fig. 24 shows that her butter-fat percentage was exactly the same as the record of her mother. The sire of this crossbred is Lakeland's Poet shown in Fig. 19. (Fig. 23.)



MONTHLY BUTTER-FAT PERCENTAGES

Graphs showing the monthly butterfat percentages of six crossbred cows and their parents. The solid line (———) represents the crossbred, the dotted line (......) represents the dam, and the dot-and-dash line (—·—·—) the potential record of the sire. (Fig. 24.)



MONTHLY BUTTER-FAT PERCENTAGES

Graphs showing monthly butter-fat percentages of crossbred cows and their parents. The significance of the lines is the same as in Fig. 24 on the opposite page. (Fig. 25.)

is the result of the mating of the Aberdeen-Angus cow Orono Madge to the Holstein-Friesian bull Taurus Creamelle Hengerveld. The graph for Crossbred No. 44 shows that her butter-fat percentage for her first lactation is intermediate between that of her high and her low testing parents at the fourth, fifth and sixth months of lactation. Other than these months the crossbred cow clearly follows the low butter-fat percentage of her low testing sire. The eight months mean butter-fat percentage for Crossbred No. 44 was 3.656 per cent, that for her Aberdeen-Angus dam 4.640 per cent, and for her Holstein-Friesian sire 3.399 per cent. The crossbred cow was consequently 0.984 per cent less in her butter-fat percentage than her high testing dam and 0.257 per cent more than her low testing sire. The crossbred cow consequently is 3.8 times as near to the low butter-fat percentage as she is to the higher butter-fat percentage line.

These observations may be regrouped to show the changes brought about in the butter-fat percentage of the offspring in accordance with the way the cross was made. For those crosses in which the Holstein-Friesian sire was used, the offspring in all cases resembled the low testing sire between 3.3 and 4.5 to 1 as closely as they did the high testing parent, the mean being 3.9 to 1. For those crosses in which the dam was of the Holstein-Friesian breed, the results of the offspring were contradictory, one approaching the butter-fat percentage of the high test parent 1.4 to 1 and the other approaching the butter-fat test of the low Holstein-Friesian cow 7.3 to 1. The cross involving the Ayrshire dam resembled the low test 2.6 to 1. The high test Guernsey dam when crossed to the lower test Aberdeen-Angus sire had a daughter which resembled the low testing sire 5.5 times as closely as she did the high testing dam.

Considering every cross irrespective of their merit for this particular phase of the work the crosses resemble the low testing parental breed 2.23 times as closely as they do the high testing parental breed.

Several experiments undertaken by the breeders cited in the previous papers furnish data which incidentally bear on the inheritance of butter-fat percentage. The butter-fat tests given by Parlour, Kuhlman, and Strevens[4] for the F_1 cows from crosses of the Jersey and Aberdeen-Angus breeds show that the F_1 differs little from either parent. This as indicated in a previous section of this paper would be expected since the Jersey and Aberdeen-Angus breeds have quite similar butter-fat tests.

In crossing Holstein-Friesian bulls to several scrub cows of rather high butter-fat test Kildee and McCandlish's[5] results show that the butter-fat percentage for the F_1 cows is intermediate between the two parents approaching if anything the butter-fat percentage of the lower testing Holstein-Friesian sires. The F_1 crosses of the Guernsey and Jersey sires to the scrubs show a slight improvement of the butter-fat percentage over that of their dams. The results for the Jersey and Guernsey crosses are of no particular importance to the discussion since the butter-fat tests of the animals crossed was nearly the same. The F_1 crosses for the Holstein-Friesian sires and scrub cows are of interest and agree quite closely with the results of the controlled experiment herein described considering that more than one sire may have been used, that age corrections were not made and that the progeny

[4] Parlour, W.
1913. Jersey Angus Cattle. Live Stock Jour. (London) 77 (1913) No. 2025 p. 85.
Kuhlman, A. H.
1915. Jersey-Angus Cattle. Journal Heredity 6 (1915) No. 2, pp. 68–72.
Strevens, H. D. E.
1913. Jersey-Angus Cattle. Live Stock Jour. (London) 77 (1913) No. 2025, p. 132.

[5] Kildee, H. H. and McCandlish, A. C.
1916. Influence of Environment and Breeding in Increasing Dairy Production. Bul. 165. Iowa Agri. Expt. Sta., pp. 383–402.

performance test of the sires is not known.

Dunne[6] quotes some Danish records to show that there are two types of cows in the red Danish breed. One of these types tests about 3.3 per cent. The other type tests about 4.00 with the cross between the two having a butter-fat percentage which is intermediate. These results are however open to considerable criticism when viewed as critical evidence. The results cannot therefore be accepted as proof.

Castle[7] records an experiment commenced by Mr. Bowlker on crosses between the Guernsey and Holstein-Friesian breeds. Unfortunately only a very limited number of tests on the original pure bred cows were made. It is necessary therefore to use the average butter-fat percentages of the breeds as the parents test for butter-fat. Such a procedure is open to error in that the breeds' average butter-fat concentration may not represent the test of the parental animals used in these experiments. In fact the wide variation of either the Guernsey or Holstein-Friesian breeds in this respect make it entirely probable that such is the case. The experiments are interesting however in that wide differences are represented in butter-fat percentages of the two breeds. The average butter-fat percentage of the Holstein-Friesian parents was assumed to be 3.3 per cent. The average test of the Guernsey parents was 5.0 per cent. The F_1 crossbred cows had an average butter-fat percentage of 4.08 or were intermediate between the two parental breeds approaching the lower testing Holstein Friesian parents more closely than the higher testing Guernsey parents. The outcome of these experiments despite the many uncontrolled variables is in essential agreement with the experiments herein reported from the Maine Station.

BUTTER-FAT PERCENTAGES COMPARED TO MILK YIELD

It is of interest to examine the results of these experiments on butter-fat percentage in the light of those for milk yield. It will be remembered that in the F_1 crossbreds milk yield was intermediate between that of the high and the low parents but approached most nearly that of the high parent. In the genetics of many economic characters as yield of grain, size of the animal etc. the explanation used to account for such a phenomena is the heterozygous nature of the factors contained in the F_1 animal as compared with the homozygous nature of the factors in the parental breeds or strains. Without question there may be something to this hypothesis for certain crosses. The results for milk yield and butter-fat percentage do present a paradoxical position when this hypothesis is applied to them. Thus milk yield is increased over what the true intermediate should be. This follows the expectation generally agreed upon and accounted for by heterosis. But on these identically same animals the butter-fat percentage is decreased below the intermediate. This is not the expectation generally considered as due to heterosis although it is by no means impossible to assume that increased vigor may reduce rather than increase a character. The double nature of such a position does not appeal to the author, however, as furnishing more than a verbal explanation of the results having little parallel in the rest of genetics. The explanation which really seems most likely is that we have in these two cases the resultant of partially dominant factors. Numerous similar cases can be cited in genetic literature. Perhaps the best known case is that of black in Drosophila where the factor for this is normally classified as a recessive but where if occasion demands it may be

[6] Dunne, J. J.
1914. Hereditary Transmission of Fat Percentage. Hoard's Dairyman. Vol. XLVII. No. 15, pp. 553.

[7] Castle, W. E.
1919. Inheritance of Quantity and Quality of Milk Production in Dairy Cattle. Proc. Nat. Acad. Vol. 5, pp. 428-434.

used as a dominant; such a factor differs quite distinctly from another like speck which is consistently recessive. Such a parallel will explain the inheritance for butter-fat percentage by considering that the factors for low butter-fat percentage display more dominance in their expression than do the factors for high butter-fat percentage.

The inheritance of butter-fat percentage has occupied a prominent place in the discussions of breeding operations by practical dairymen. These men have held the following views as to the mode of this inheritance. The first has claimed that the tendency for high or low butter-fat percentage is transmitted by the sire to his offspring; the second that the dam transmits the tendency for high or low butter-fat percentage to the offspring; and the third that both parents contribute to the butter-fat percentage transmission. The results of these experiments show that the third of these claims is correct. Such being the case the dairyman who wishes his breeding operations to progress successfully will find it desirable to examine both sides of his animals' pedigrees carefully. Thus, today, the Jersey breeder pays a good deal more attention to the sires' side of the pedigree than he does the dams' side of the pedigree when in truth both sides are equally important.

REMARKABLE INDORSEMENT OF THE JOURNAL OF HEREDITY BY THE CHIEF OF THE BUREAU OF PLANT INDUSTRY

Dr. Wm. A Taylor is the Chief of the largest plant research organization in the world—the Bureau of Plant Industry of the U. S. Department of Agriculture. Its large staff of trained research workers, backed by an extensive clerical organization, constitutes the most powerful creative force in the study of plants which the world has ever seen. It expends $2,800,000 a year, which would represent an endowment of more than twice that of the Carnegie Institution.

This unrivalled body of research workers has gathered together thousands of invaluable photographs which tell the story of new discoveries better than words do. There has never been any adequate way to bring these illustrations before the public, and this year the totally inadequate source of publication has been cut in two.

In a similar way, the large army of research workers all over the world who find that their mediums of publicity are being hampered by inadequate facilities, are looking to the Journal of Heredity as the means by which they may present their discoveries to the interested public.

Dr. Taylor's indorsement, printed on the opposite page, should appeal to everyone interested in the building up of our plant and animal industries. The production through breeding and selection which is actually going on is creating for the country hundreds of millions in wealth. Increased production, more disease resistant plants, longer, tougher fibred, better flavored and otherwise more valuable tobaccos, cottons, rices, wheats, sorghums, corns, peanuts, watermelons, peaches, potatoes, oats, barleys, flax, blueberries, citrus fruits—in fact the whole range of agricultural and horticultural plants—are actually being effected by the workers in this new field of science, and when Dr. Taylor says that no other scientific journal in America equals the Journal of Heredity in respect to its power to communicate and preserve the basic information relating to plant and animal improvement, he speaks from a quarter of a century's intimate experience with the conditions as they are.

The Journal of Heredity has an appeal to everyone who wants to see the photographs which show the progress in this field which is easily and rapidly becoming one of the greatest of all in its ability to create wealth.

Department of Agriculture,
Bureau of Plant Industry.
Washington, D. C.

November 6, 1920.

Dear Dr. Fairchild:

In your consideration of the future of the Journal of Heredity I hope you will not overlook the very important relation to practical agriculture which the Journal has developed. While its title hardly suggests it, and I am free to confess when its publication began I personally did not expect it, the Journal has become a very effective medium for the communication and preservation of much basic information relating to plant and animal improvement. No other scientific journal in America equals it in this respect, nor do the official channels of publication such as those of the Department of Agriculture and the State Agricultural Experiment Stations hold out any promise of meeting this need.

The catholicity of its editorial policy, coupled with the quality of its illustrations, is rapidly making it the most important journal for plant and animal breeders in the country at a time when these basic activities in agricultural development need it most keenly.

I sincerely hope that the Association will find it possible to continue the issue of the Journal without abridgment of quality or frequency of issue.

Sincerely,
(Signed) Wm. A. Taylor.

Dr. David Fairchild, President,
American Genetic Association,
Washington, D. C.

A HERD OF ALBINO CATTLE

J. A. Detlefsen

College of Agriculture, University of Illinois, Urbana

About six years ago, Mr. Martin Kaslow of Mora, Minnesota, obtained two albinotic calves—a bull and a heifer. The calves were the result of mating a so-called full-blooded Holstein bull to grade Holstein cows. The parents were of normal coat color, black and white spotted. Unfortunately, the bull was killed before his offspring were born. Mr. Kaslow was attracted by the beautiful white coat and pink eyes of the calves and proceeded to make matings for the purpose of increasing the number of albinos. He was entirely successful in his efforts and secured a score or more albinos in the course of a few years.

My attention was drawn to this interesting herd through the courtesy of Professor H. K. Hayes, of the College of Agriculture, University of Minnesota, and I corresponded with the local county agent and Mr. Kaslow to obtain details of the case. Unfortunately, Mr. Kaslow's records were destroyed in a fire, and the following comments depend on his memory to a large extent, supplemented by such observations as I was able to make when opportunity was afforded to examine the herd. While not questioning the correctness of the data, I can not vouch for their accurary, since they depend upon a memory of events which took place during the course of several years. However, since the herd is quite unique, at least a record of its existence should be made.

UNUSUAL RECORD OF ALBINO BULL

The original full-blooded Holstein bull was mated to about twenty unrelated grade Holsteins producing a bull and a heifer albino, and the rest normal. In the absence of more data, the case would appear like other simple cases of albinism in which a heterozygous male was accidentally mated to similar females and naturally some albino segregates appeared. But the subsequent matings, according to Mr. Kaslow's statement, do not bear out such a simple hypothesis, for the young F_1 albino bull was mated back to the grade Holstein cows and produced only albinos—about twenty in number. If Mr. Kaslow's observations are correct, the case is rather remarkable, for an original mating of normal-coated Holsteins gave an apparent recessive segregate—an albino bull. And yet this bull acted like a homozygous dominant in matings with normally-coated Holstein cows.

Mr. Kaslow states that the albinos, when mated *inter se*, have given only albinos and exhibited four young albino calves which were reported to have come from such a mating. Furthermore, four albino females were mated to a registered Holstein bull and produced three albinos and one normal Holstein.

NOT CORRELATED WITH MILK PRODUCTION

As far as I could determine by examination, the albinos showed no pigment in the skin, eyes, horns, or hoofs, except in one case. One adult female had a small black spot about one centimeter square on one ear. Mr. Kaslow had not noted any similar appearances of pigment in other individuals and was somewhat surprised when this case was pointed out to him. The albinos were extremely sensitive to light and grazed in a listless manner during the daytime with their eyes partly closed and their pupils contracted. In the evening, the vision was apparently normal, and the albinos showed much more animation. The albino character seems to be uncorrelated with milk production for this albino herd produces about the same amount of milk expected of similar grades.

ALBINO CATTLE

A full-blooded Holstein bull mated to about twenty unrelated grade Holstein cows produced two albino calves, the rest of the offspring being normal. Subsequent matings increased the number of albinos to twenty or more. The herd furnishes an interesting case of albinism. (Fig. 26.)

ATTRACTIVE WHITE COAT AND PINK EYES

Examination of the herd showed no pigment in the skin, eyes, horns or hoofs. The cattle were very sensitive to light, and grazed more actively in the evening than in daytime. (Fig. 27.)

DETERIORATION IN SOME HORTICULTURAL VARIETIES THROUGH DEFICIENT ARTIFICIAL SELECTION

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THE following data have been gathered during the summers of 1917, 1918 and 1919, and when analyzed would seem to indicate that these horticultural varieties of several decorative plants, chiefly annuals, have seriously deteriorated from their type standards. An attempt to inquire into the causes for this deterioration leads one to believe that the fault lies with the producers of the seed and their failure to maintain careful artificial selection in breeding these varieties. It is assumed that the war and the consequent labor conditions are to account for the situation. The observations here presented may also be of use to indicate the more labile characters in these particular varieties and possibly by thus analyzing their hereditary constitution, material may be secured in them for genetical studies.

UNIFORM METHODS OF CULTIVATION

For many years it has been the writer's privilege to cultivate each summer at his home in eastern Pennsylvania, a small garden containing many varieties of herbaceous and shrubby perennials and bulbous plants. In the more open borders are usually planted the common annuals and biennials, such as asters, poppies, zinnias, marigolds, balsams, pansies, mignonette, delphiniums, etc. The seeds for these plants have annually been purchased from the largest and most reliable seedsmen in the East and have always produced excellent results. In some instances *Centaureas*, *Scabiosa*, seedling *Dahlias* and *Salpiglossis* have been exhibited. The soil and ordinary cultural methods have been practically the same for a long period, and with good seed from reliable sources the conditions, so far as germination and growth are concerned, have been unchanged in the successive seasons. All these conditions, therefore, being so uniform, any extraordinary variation in results good over a long period preceding would, naturally, not be due to the cultivation. The explanation must be sought in the seeds.

The same varieties were grown in the two summers preceding that of 1919, and the same deterioration was observed in these particular varieties, but even in a more marked degree was it noticed in the season mentioned. As the observations were more carefully taken this past summer, only the data for that period are here set forth. In the spring of 1919 seeds were purchased of named varieties of the China Aster, *Callistephus chinensis*, *Zinnia elegans; Tagetes erecta*, the African marigold; *Matthiola incana* and the corn-flower, *Centaurea cyanus*, together with seeds of other decorative plants and garden vegetables. These named varieties had been bought of the same firm in the preceding years and were planted under similar conditions in the same garden, and all germinated with excellent percentages.

Before proceeding in detail with the results of the plantings of the genera named above, it should be mentioned that the crops produced from vegetable and other seeds were in the highest degree satisfactory and that these seeds were evidently up to the standard of previous years. The need for propagating large quantities of food plants during the war period obviously was an incentive for breeders to maintain as high a standard of quality as possible.

EVIDENCE OF DEGENERATION IN SEEDS

The asters were of three varieties—white, pale pink and lavender in standard named strains. The florets have long and slightly twisted rays or ligules of the type popularly called "Chrysanthemum" asters. The seed germinated in good time with 97 per cent viable plants when set out, and the plants immediately made good growth.

The season was very favorable and the usual fungicides and insecticides applied prevented the attacks of pests, so that late in August the asters came into bud prolifically. So far these plants were identical with those of the same strains grown in other seasons. But first of all it was noted, when the heads began to expand, that, though equal plantings had been made of all three colors, only a scant proportion of the plants were of the pale pink color, indicating that, of the seeds so labeled, only a few really carried the factor for that color. This may have been an error originating in the packing of the seeds but on account of the presence of some of the desired color, and that in varying degree, it could be assumed that the strain was not carefully segregated in breeding at the seed farm and that the phenomenon was really genetic.

A more striking evidence, however, of the deterioration of this stock was seen in the form of all three colors. The ray florets had much shorter ligules and with a less pronounced curl so that the flowers were scarcely recognized as being of that distinctive named variety. The plants were strong and well nourished, but these asters had degenerated in regard to length of the ligules and the amount of "curl" in them and were losing the character for "pinkness."

VARIATIONS IN ZINNIAS

The *Zinnia etegans* strain was of a type normally having tall-growing stems and full double flowers and characterized especially by long peduncles. The latter feature is desirable in this type of *Zinnia* so that it may be used for cutting. The more dwarf bedding sorts have shorter internodes and shorter peduncles, thus giving a mass effect of bloom. Instead of these *Zinnias* coming true to their varietal characters, with long internodes and peduncles, there was a pronounced shortening in these axes, although the plants attained a good size and luxuriant growth and all signs of any depauperation were absent, both in the synthetic tissues and the inflorescences. There was a tendency also for these *Zinnias* to revert in color to the reddish magenta of the ancestral type indigenous to Mexico, and in form to produce some disk florets in the center of the very large heads mainly composed of ray florets with very broad ligules, instead of the full double form with densely packed heads of ligules all of a uniform size. The *Zinnia* may then be said to deteriorate in the shortening of the internodes and peduncles and reversal to fewer rays and purple color.

THE AFRICAN MARIGOLD

Tagetes erecta, the African marigold, is an especially easy annual to grow. With ordinary good culture it will produce large full-double heads which frequently become too heavy for the peduncle and break under their own weight. The well grown plants of the 1919 season set an abundance of buds but the lack of uniformity in the stature of the plants in the same plot presaged differences in inheritance of these various individuals. In one plot specimen plants had been set out two feet apart, so the ample room for development was assured each plant, but here too the same variations in stature occurred. That the strain was contaminated with a dwarf type, perhaps even mixed with another species, as *T. patula* or *T. signata*, would account for this variation.

The two varieties selected for planting were tall growing sorts of two shades, one a clear yellow and the other a deeper orange. The fact that as many plants of the lighter color reached maturity as of the darker color, in

proportion to their occurrence in the population, indicated again that there was no adverse factor in the cultural methods, since the paler varieties are less hardy and succumb to hard conditions more quickly than the deeper tinted varieties in species having the normal types colored (as de Vries[1] and others have pointed out) or in which the ancestral form is a deeply colored species. A survey, however, of the whole population of these marigolds showed that there was a far greater proportion of the orange tint. Since the germination percentage was very high, almost every seed having been viable, and no plants were lost in setting out, the conclusion is drawn that the paler type had been overcome in breeding and was masked by the more dominant or atavistic orange factor. This variation in stature and small proportion of clear yellow tints had already been observed in the plants grown in 1917 to a marked degree.

In the named types of these marigolds the peduncle is somewhat expanded at the inflorescence to form an urn-shaped cup and the ray florets surrounding the edge of this cup develop first, a capitulum, of course being an indeterminate inflorescence. The inner florets grow up from the more central part of this involucral urn and in the perfect type of these varieties there is a great elongation of the ligules of the central florets, so that the whole head represents a highly piled mound of rays with graduated lengths of ligule increasing from the circumference to the center. In the plants grown during the last three years, the central florets either reverted completely to the original species form of disk florets, with tubular corollas, or if the ligules were retained they did not elongate, so that the peduncular urn bore only one or two rows of rays about its circumference, and the center was a descending hollow of undeveloped or partial ligules.

Budding and additional food did not help matters or produce the large head of full ligulate florets. It illustrated the tendency in *Tagetes* to go back to a simple composite type with dimorphic corollas within two or three generations of deficient artificial selection. The special feature showing, perhaps, most deterioration was the failure of the central ligules to elongate, thus forming sort of funnel-shaped inflorescence or the complete reversal to the disk type. In passing, it may be remarked that the plants were most prolific in setting seed, which is only another evidence of deterioration in highly bred or hybrid stock.

EARLY VARIATIONS IN THE STOCKS

The stocks, *Matthiola incana*, were sown early and set out under the most favorable conditions in an open bed with considerable space about each plant. By mid-summer each had become a sturdy tufted specimen-plant with a strong woody base. Later, when the inflorescences began to form, these plants gave every promise of what should have been dense trusses of double blossoms in tints of pink, red, yellows, white, lavender and purple. An early indication of variation was noted, however, in these plants when the leaves of adjacent plants were compared. The foliage of the type is densely tomentose but in these individuals all stages were found—from heavy gray velvety tomentum to an almost completely glabrous condition. Considerable variation was also observed in the width of the leaves. When the rather loosely arranged spikes and the blossoms were fully developed, it was a surprise to find that the color range included only the white, lavender and purple. The more delicate rose, pink and yellow had all been submerged in the dominant purple. The petals were broad and most of the stamens perfectly developed and the inflorescence bore flowers almost the entire length of its usual tetramerous form, but with very few petaloid stamens. In these Stocks, just as in the marigolds, the heterozygous strains were very prolific and matured abundant seed. In *Matthiola*,

[1] de Vries: Mutationstheorie—*Oenothera Lam.* var. *albida*.

then, we have evidence of considerable reversal to the simple cruciferous ancestral forms which were presumably purple, and signs of mixed heredity in high degree of fertility and the variations in the foliage.

THE CENTAUREA

In the *Centaurea* the type was of a very deep blue color with at least three or more rows of false rays. Reversal was seen in over fifty percent of the plants in the population of this sowing, as the heads had only one, or at the most, two rows of false rays and an increase of functional disk florets. In color also there was evidence of contamination of the strain. Beside the deep blue of the type there were all shades of lighter blue, as well as white, pink and maroon, showing that this strain had not been carefully selected and segregated at the seed-farm.

CARELESS SELECTION OF SEED-PARENTS

In all these foregoing examples, it may be deducted that many standard horticultural varieties have considerably deviated from their types. In these particular cultures the fact that the growth conditions were uniform, and other factors which would have lowered the vitality of the generation, such as fungous and bacterial diseases, were absent, should be conclusive evidence that causes for this deviation have been inherently genetic, i.e. that the seed was of poor quality and contaminated with other and dominant inferior strains, or that there was a general lowering, reverting and atavistic tendency due to unknown physiological conditions at the breeding farms, which has affected the germplasm of these varieties.

In regard to careless selection by the breeders of the seed-parents having the desired characters, or perhaps the failure to keep up the nutrition or some other cultural condition on the farms, or the lack of careful and skilled pollination, much, or perhaps all, can be attributed to the war—directly due to the lack of labor on the seed-farms; but in all events this deterioration in stock has occurred and it may be several years until these strains are again recovered or are replaced by new ones.

WHAT THESE OBSERVATIONS INDICATE

Another and rather interesting feature of these observations was the recognition of those hereditary factors in these particular varieties which are least fixed or stable in the constitution of these plants. Some of these have become conspicuous by their complete disappearance or modification. On the other hand those characters which are dominant and persist to the last may only mask or cover those more unstable characters which apparently have disappeared.

Of course, from a purely genetical point of view, these horticultural varieties are far removed from the simple strains of known heredity which are usually chosen as material for genetical investigation and research. Most all horticultural varieties are sports or the results of very complex hybridizations and cross pollinations, and if actual inbreeding experiments should be carried on with them through four, five or more generations for the segregation of Mendelian characters, all sorts of peculiar results might be expected from these much mixed and heterozygous strains.

In conclusion, then, it may be repeated that these observations perhaps indicate some of the less firmly fixed characters in the heredity of these varieties which have undergone a deterioration from their standard types.

MEETING OF GENETICISTS INTERESTED IN AGRICULTURE

The place of genetics in the curriculum in agricultural colleges, and cooperation in genetic investigations, were among the several subjects discussed in a special meeting of geneticists held in Chicago December 28th in conjunction with the meetings of the American Association for the Advancement of Science and affiliated societies.

Among the speakers at the meeting were Professors L. J. Cole of Wisconsin, J. A. Detlefsen of Illinois, R. A. Emerson of Cornell, E. B. Babcock of California, S. A. Beach of Iowa, M. J. Dorsey of Minnesota, and D. F. Jones of Connecticut. Fifteen Agricultural Colleges and Experiment Stations, besides the U. S. Department of Agriculture and other institutions, were represented.

A resolution was adopted favoring the establishment of a single department of genetics in agricultural colleges. Many institutions now have their instruction and research in genetics scattered throughout many departments with no one department responsible for a fundamental course. To simplify administration and prevent duplication, and give proper standing to the subject of genetics in the curriculum, it is recommended that each institution have a department of genetics to handle the courses of instruction and direct the investigational work, and cooperate with, but not control, investigational work in the specialized problems of genetics.

SECOND INTERNATIONAL EUGENICS CONGRESS

The Second International Eugenics Congress will convene in New York City September 22, 1921. It will be a conference on the results of research in race improvement. The First International Congress was held in London in 1912. Since then the world war has come and gone, leaving the economic, sociologic and biologic conditions everywhere greatly disturbed. Never before has the need of international cooperation and enlightenment been felt so keenly. The Second Eugenics Congress is therefore meeting at a time of exceptional interest.

The conference will be divided into three sections. In the first, the results of genetic research in animals and plants will be presented, and also studies in human heredity. The second section will consider factors which influence the human family, and their control, and the third will concern itself with the topic of human racial differences—the influence of racial characteristics on human history and their bearing on the policies of the future, modern immigration being especially set forth.

Representatives from nearly every country of the world are expected to be at this congress. The Secretary-General is Dr. C. C. Little, American Museum of Natural History, New York City.

The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

JANUARY, 1920

Vol. XI, No. 1

ORGAN OF THE

AMERICAN GENETIC·ASSOCIATION

WASHINGTON · D C.

Printed for Circulation among Members only

Acceptance for mailing at the special rate of postage provided for in section 1103, Act of October 3, 1917 authorized December 20, 1918.

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Hundreds of members are engaged in collecting facts about inheritance, and making experiments to determine the laws of heredity. Their discoveries are of fascinating interest and far-reaching importance to the city dweller and the country dweller alike. These findings are being reported and discussed every month in the Journal, and in no better way can serious minded people keep abreast of one of the greatest movements of modern science.

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The Journal of HEREDITY

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FEBRUARY, 1920

Vol. XI, No. 2

ORGAN OF THE

AMERICAN GENETIC ASSOCIATION

WASHINGTON · D.C.

Printed for Circulation among Members only

Acceptance for mailing at the special rate of postage provided for in section 1103, Act of October 3, 1917, authorized December 20, 1918.

The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

MARCH, 1920

Vol. XI, No. 3

ORGAN OF THE
AMERICAN GENETIC·ASSOCIATION
WASHINGTON · D.C.
Printed for Circulation among Members only

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APRIL, 1920

Vol. XI, No. 4

ORGAN OF THE
AMERICAN GENETIC ASSOCIATION
WASHINGTON · D.C.

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Acceptance for mailing at the special rate of postage provided for in section 1103, Act of October 3, 1917, authorized December 20, 1918.

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Civilization is now entering a stage in which it is necessary that the human race have correct ideas of heredity. These matters are not to be dealt with by any system of prescriptions or directions to be handled by a few experts. They will require the most general comprehension of the facts that it is possible to secure. Although the importance of plant and animal breeding and eugenics is recognized, the public is not informed to the point of a practical understanding of the biological principles, or of the applications that are possible.

To get these correct ideas of heredity before the public the students of the subject must be heard and the photographs arranged by them must be seen. It is the most difficult thing in the world for anyone but the discoverer himself to place the facts correctly before the world. **This Journal contains the opinions of the real students—not the exaggerated interpretations of professional journalists.**

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The scientific men who are working to make this Journal a success are **giving their time and articles without pay.** They do not have the money to give, for as you know such workers are still underpaid. They want to **make the Journal self-supporting.** They have seen the membership grow from its small beginning to its present size. It has come through the war, and has increased its membership 15 per cent this year. It now goes to members in 29 different countries of the world. **But it costs twice what it did before the war to publish the Journal.**

A little effort by each member now would make this Association large enough to be *a permanent meeting ground between the students of heredity throughout the world and the general public.*

From those who have youth and enthusiasm we want members. From those who have money we ask for bequests or direct financial support.

Nominate by letter those who ought to be members. See back cover.

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"Eugenics is the study of agencies under social control that may improve or impair the social qualities of future generations, either physically or mentally."

"An exact determination of the laws of heredity will probably work more change in man's outlook on the world, and in his power over nature, than any other advance in natural knowledge that can be clearly foreseen.

"To gain this knowledge is the object of the science of genetics. which proceeds in practice, largely by means of plant breeding and animal breeding for the reason that heredity is less complicated in these organisms than in man, and its operation can be more easily made out. The knowledge so gained finds its application in methods for the improvement of cultivated plants and domesticated animals and, most important of all, in the improvement of the human race, through the science of eugenics."

GENETICS LITERATURE

The annual reports of the American Breeders' Association, published in seven volumes, form one of the most valuable collections of material for students of genetics which has been published in the United States. Volumes I to V are no longer available, but the Association still has on hand a few copies of Vol. VI for sale at $1.00 and Vol. VII-VIII at $1.50.

The Association desires to purchase copies of Volumes I to V of the Proceedings A. B. A., and will be glad to hear from anyone having copies for sale.

Former issues of the Journal of Heredity, so far as they are available, are for sale at 25 cents each, postpaid.

NATIONAL CAPITAL PRESS, INC., WASHINGTON, D. C.

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A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

ORGAN OF THE

AMERICAN GENETIC ASSOCIATION

WASHINGTON · D.C.

Printed for Circulation among Members only

Volume XI, Number 5 May-June, 1920

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WASHINGTON · D.C.
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Volume XI, Number 6 July-August, 1920

The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

ORGAN OF THE
AMERICAN GENETIC ASSOCIATION
WASHINGTON · D.C.
Printed for Circulation among Members only

Volume XI, Number 7 September-October, 1920

The Journal of HEREDITY

A monthly publication devoted to Plant Breeding Animal Breeding and Eugenics

PUBLISHED QUARTERLY AT MENASHA, WISCONSIN
BY THE
AMERICAN GENETIC ASSOCIATION
EDITORIAL AND GENERAL OFFICES
WASHINGTON, D. C.

Volume XI, Number 8 November-December, 1920

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